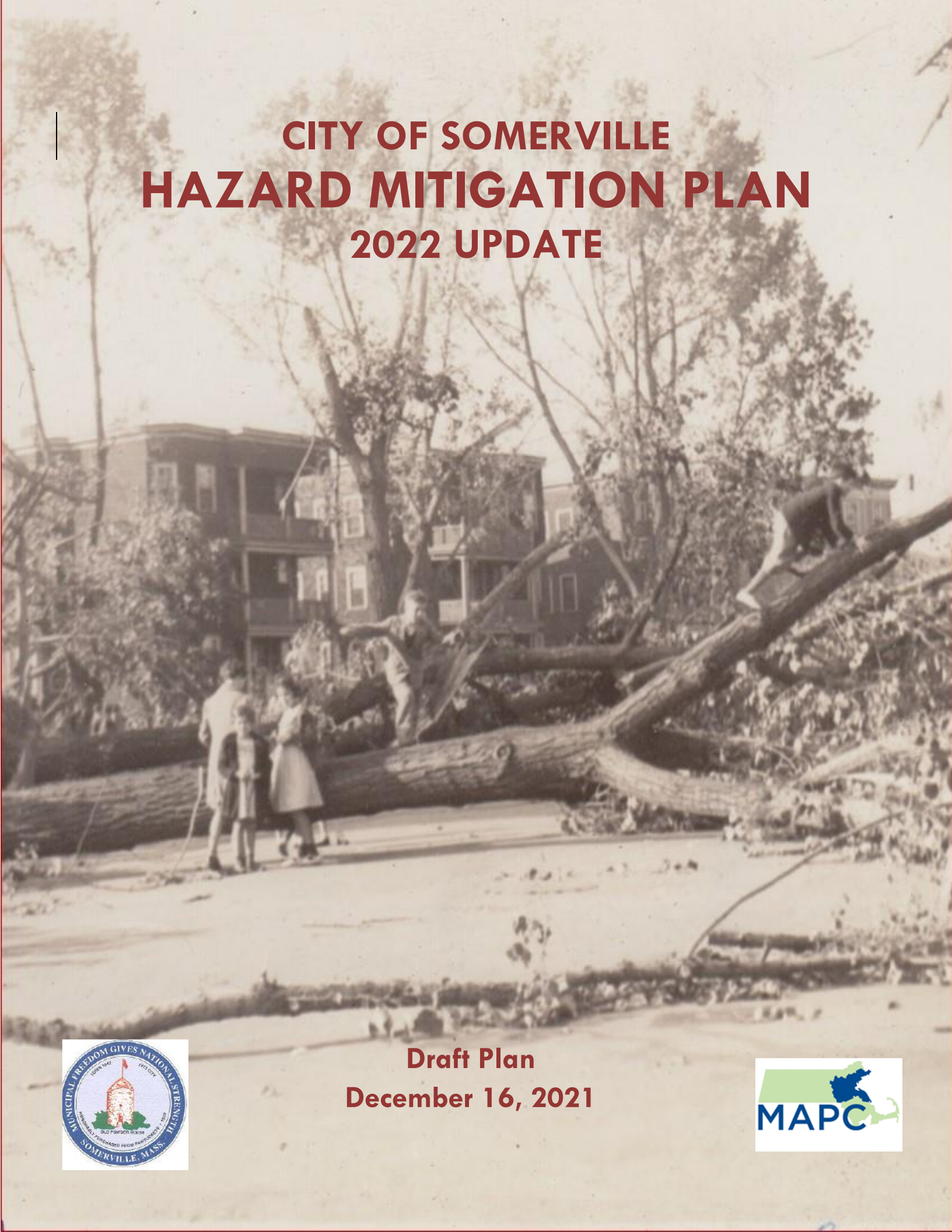

CITY OF SOMERVILLE
HAZARD MITIGATION PLAN
2022 UPDATE

Draft Plan
December 16, 2021

Cover photo: The Hurricane of 1938 in Somerville, MA
Courtesy of the Somerville Public Library

ACKNOWLEDGEMENTS & CREDITS

This plan was prepared for the City of Somerville by the Metropolitan Area Planning Council (MAPC) under the direction of the Massachusetts Emergency Management Agency (MEMA) and the Massachusetts Department of Conservation and Recreation (DCR). The plan was funded by the Massachusetts Emergency Management Agency (MEMA) through a FEMA grant.

MAPC Officers
President, Erin Wortman, City of Stoneham
Vice President, Adam Chapdelaine, City of Arlington
Secretary, Sandra Hackman, City of Bedford
Treasurer, Sam Seidel, Gubernatorial
Executive Director, Marc Draisen, MAPC

Credits

Project Manager:	Martin Pillsbury
Mapping/GIS Services:	Alyssa Kogan
Qualtrics Survey:	Christian Brandt
	Elise Harmon

Massachusetts Emergency Management Agency

Acting Director:	Dawn Brantley

Department of Conservation and Recreation

Commissioner:	Stephanie Cooper

Somerville Hazard Mitigation Planning Team

Chief Charles Breen	Fire Chief, Fire Dept.
Danielle O'Hearn	Lieutenant, Homeland Security, Fire Dept, HMP Team Coordinator
Christopher Major	Assistant Chief, Fire Dept.
Thomas E. Graney	Homeland Security Coordinator, Fire Dept.
Charles Femino	Acting Chief, Police Dept.
Timothy Mitsakis	Lieutenant, Police Dept.
Scott Whalen	Sergeant Police Dept.
Sal Fusco	Sergeant, Police Dept.
Brian Postlewaite	Director of Engineering
Oliver Sellers-Garcia	Director, Office of Sustainability and Environment
Vithal Deshpande	Environmental Coordinator, Office of Sustainability and Environment
Douglas Kress	Director of Health and Human Services
Jill Lathan	Director of Parks & Recreation; Acting Commissioner, Dept. of Public Works
George Proakis	Executive Director, Strategic Planning and Community Development
Christine Blais	Acting Director, Office of Sustainability and Environment
Justin Kates	Director, Emergency Management

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SECTION 1: EXECUTIVE SUMMARY

Hazard Mitigation planning is a proactive effort to identify actions that can be taken to reduce the dangers to life and property from natural hazard events. In the communities of the Boston region of Massachusetts, hazard mitigation planning tends to focus most on flooding, the most likely natural hazard to impact these communities. This plan considers how our changing climate will affect natural hazards. Warming temperatures will fuel changing precipitation patterns, sea level rise, and an increasing frequency and intensity of severe storms. The Federal Disaster Mitigation Act of 2000 requires all municipalities that wish to be eligible to receive FEMA funding for hazard mitigation grants, to adopt a local multi-hazard mitigation plan and update this plan in five-year intervals.

PLANNING PROCESS

Planning for the Hazard Mitigation Plan update was led by the Somerville Local Hazard Mitigation Planning Team, composed of staff from a number of different city departments. the team met on July 7, 2021, September 13, 2021, and November 15, 2021, and discussed where the impacts of natural hazards most affect the city, the effects of climate change, goals for addressing these impacts, updates to the City's existing mitigation measures, and new or revised hazard mitigation measures that would benefit the city.

Public participation in this planning process is important for improving awareness of the potential impacts of natural hazards and to build support for the actions the city takes to mitigate them. The City's Local Hazard Mitigation Planning Team hosted two public meetings. The first meeting was hosted by the Conservation Commission via Zoom on October 26, 2021. The second meeting on December 1, 2021, was hosted by the Hazard Mitigation Team via Zoom and the draft plan update was posted online for public review. Key city stakeholders and neighboring communities were notified and invited to review the draft plan and submit comments. One public comment was received (see Appendix E). As a result, an additional local flooding site at Lake Street was added.

RISK ASSESSMENT

The Somerville Hazard Mitigation Plan assesses the potential impacts to the city from flooding, high winds, winter storms, brush fire, geologic hazards, extreme temperatures, drought, and invasive species. For each risk, the assessment identifies the projected impacts of a warming climate. These are shown in the map series in Appendix B. The Somerville Local Hazard Mitigation Planning Team identified 143 Critical Facilities, including 131 from the 2016 plan and 12 additional facilities added for this 2022 plan update. These are also shown on the map series and listed in Table 32 , identifying which facilities are located within the mapped hazard zones.

Hazards U.S. – Multihazards (HAZUS-MH) is a standardized methodology developed by FEMA that utilizes Geographic Information Systems (GIS) to estimate physical, economic, and social impacts of disasters. The HAZUS-MH analysis for Somerville estimates property damages from

Hurricanes of category 2 and 4 from $52.5 million to $246.6 million; see Table 17 for the hurricane Saffir-Simpson Scale defining hurricane categories. HAZUS-MH estimates property damage from earthquakes of magnitudes 5 and 7 from $1. 7 billion to $10.4 billion); see Table 28 for the Richter Scale defining earthquake severity. The estimated property damage from the 1% and 0.2% chance of flooding ranges from $127.4 million to $142.2 million. An explanation of the annual chance or annual exceedance probability of floods can be found at: https://www.usgs.gov/special-topics/water-science-school/science/100-year-flood

HAZARD MITIGATION GOALS

The Somerville Local Hazard Community Planning Team endorsed the following hazard mitigation goals at the September 13, 2021, team meeting. The team added a tenth goal focused on incorporating future climate change projections.

1. Prevent and reduce the loss of life, injury and property damages resulting from natural hazards.
2. Identify and seek funding for measures to mitigate or eliminate each known significant flood hazard area.
3. Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees, and boards.
    - Ensure that the Planning Department considers hazard mitigation in its review and permitting of new development.
    - Review zoning regulations to ensure that the ordinance incorporates all reasonable hazard mitigation provisions.
    - Ensure that all relevant municipal departments have the resources to continue to enforce codes and regulations related to hazard mitigation.

4. Prevent and reduce the damage to public infrastructure resulting from all hazards.
    - Begin to assess the vulnerability of municipal buildings and infrastructure to damage from an earthquake.
    - Maintain existing mitigation infrastructure in good condition.
5. Encourage the business community, major institutions, and non-profits to work with the City to develop, review and implement the hazard mitigation plan.
6. Work with surrounding communities, state, regional and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.
    - Participate in the Metro Mayors Climate Task Force and the Resilient Mystic Collaborative to address regional hazards and mitigation.
7. Ensure that future development meets federal, state, and local standards for preventing and reducing the impacts of natural hazards.
8. Educate the public about natural hazards and mitigation measures that can be undertaken by property-owners.
    - Provide information on hazard mitigation activities in the languages most frequently spoken in Somerville.

9. Take maximum advantage of resources from FEMA and MEMA to educate City staff and the public about hazard mitigation.
10. Consider the impacts of climate change and incorporate climate sustainability and resiliency into the City's planning and policies.
11. Prioritize equity in all aspects in all aspects of Hazard Mitigation planning and implementation.

HAZARD MITIGATION STRATEGY

The Somerville Local Hazard Mitigation Planning Team identified a number of mitigation measures that would serve to reduce the City's vulnerability to natural hazard events. Overall, the hazard mitigation strategy recognizes that mitigating hazards for Somerville will be an ongoing process as our understanding of natural hazards and the steps that can be taken to mitigate their damages changes over time. Global climate change and a variety of other factors will impact the City's vulnerability in the future, and local officials will need to work together across municipal lines and with state and federal agencies in order to understand and address these changes. The Hazard Mitigation Strategy will be incorporated into the City's other related plans and policies.

PLAN REVIEW & UPDATE PROCESS

The process for developing Somerville's Hazard Mitigation Plan 2022 Update is summarized in Table 1.

1: Plan Review and Update Process

Section	Reviews and Updates
Section 3: Public Participation	The Local Hazard Mitigation Planning Team placed an emphasis on public participation for the update of the Hazard Mitigation Plan, discussing strategies to enhance participation opportunities at the first local committee meeting. During plan development, the plan was discussed at two public meetings hosted by the Hazard Mitigation Team and the Conservation Commission. The plan was also available on the City's website for public comment. See Appendix E for comments received by the City..
Section 4: Risk Assessment	MAPC gathered the most recently available climate, hazard and land use data and met with city staff to identify changes in local hazard areas and development trends. City staff reviewed critical infrastructure with MAPC staff in order to create an up-to-date list. The Risk Assessment integrates projected climate impacts. MAPC also used the most recently available version of HAZUS and assessed the potential impacts of flooding using the latest data.
Section 5: Goals	The Hazard Mitigation Goals were reviewed and endorsed by the Somerville Local Hazard Mitigation Planning Team.

Section 6: Existing Mitigation Measures	The list of existing mitigation measures was updated to reflect current mitigation activities in the city.
Sections 7 and 8: Hazard Mitigation Strategy	Mitigation measures from the 2016 plan were reviewed and assessed as to whether they were completed, in progress, or deferred. The Local Hazard Mitigation Planning Team determined whether to carry forward measures into the 2022 plan Update or modify or delete them. The Plan Update's hazard mitigation strategy reflects both new measures and measures carried forward from the 2016 plan. The Local Hazard Mitigation Team provided cost estimates where available, time frames for implementation, and prioritized the mitigation measures based on current conditions.
Section 9: Plan Adoption & Maintenance	This section of the plan was updated with a new on-going plan implementation review and five-year update process that will assist the City in incorporating hazard mitigation issues into other City planning and regulatory review processes and better prepare the City for the next comprehensive plan update.

As indicated in Table 37, Somerville made good progress implementing mitigation measures identified in the 2016 Hazard Mitigation Plan. Somerville made progress implementing several mitigation measures identified in the 2016 Hazard Mitigation Plan. The Somerville Avenue drainage improvements, 137 Washington Street bridge, Cedar Street and Hall Street relief drain, and Somerville Bike Path drainage improvements have been completed. Projects partially completed include the Inner Belt Industrial Park drainage improvements, the Medford Street underpass, and Green Infrastructure implementation.

Overall, eleven mitigation measures from the 2016 plan will be continued in the plan update. Four of these are revised to reflect current priorities. Moving forward into the next five-year plan implementation period there will be many more opportunities to incorporate hazard mitigation into the City's decision-making processes. The city will document any actions taken within this iteration of the Hazard Mitigation Plan on challenges met and actions successfully adopted as part of the ongoing plan maintenance to be conducted by the Somerville Hazard Mitigation Team, as described in Section 9 Plan Adoption and Maintenance.

SECTION 2: INTRODUCTION

PLANNING REQUIREMENTS UNDER THE FEDERAL DISASTER MITIGATION ACT

The Federal Disaster Mitigation Act, passed in 2000, requires that after November 1, 2004, all municipalities that wish to continue to be eligible to receive FEMA funding for hazard mitigation grants, must adopt a local multi-hazard mitigation plan and update this plan in five-year intervals. This planning requirement does not affect disaster assistance funding.

Federal hazard mitigation planning and grant programs are administered by the Federal Emergency Management Agency (FEMA) in collaboration with the states. These programs are administered in Massachusetts by the Massachusetts Emergency Management Agency (MEMA) in partnership with the Department of Conservation and Recreation (DCR).

The City of Somerville contracted with the Metropolitan Area Planning Council (MAPC), to assist the City in updating its third local Hazard Mitigation Plan, which was first adopted in 2007 as a multijurisdictional plan and updated as a single municipality plan in 2016.

WHAT IS A HAZARD MITIGATION PLAN?

Natural hazard mitigation planning is the process of determining how to systematically reduce or eliminate the loss of life and property damage resulting from natural hazards such as floods, earthquakes, and hurricanes. Hazard mitigation means to permanently reduce or alleviate the losses of life, injuries, and property resulting from natural hazards through long-term strategies. These long-term strategies include planning, policy changes, programs, projects, and other activities. This plan incorporates consideration of future risks due to projections for the increased frequency and severity of extreme weather fueled by a warming planet.

PREVIOUS FEDERAL/STATE DISASTERS

Since 1991, there have been 24 natural hazard events that triggered federal or state disaster declarations that included Middlesex County. These are listed in Table 2 below. The majority of these events involved flooding, while others were due to hurricanes or nor'easters, and severe winter weather.

Table 2: Presidentially Declared Disasters 1991-2018

Disaster Name	Date of Event	Declared Areas
Hurricane Bob	August 1991	Counties of Barnstable, Bristol, Dukes, Essex, Hampden, Middlesex, Plymouth, Nantucket, Norfolk, Suffolk
Severe Coastal Storm	October 1991	Counties of Barnstable, Bristol, Dukes, Essex, Middlesex,

Disaster Name	Date of Event	Declared Areas
No Name Storm		Plymouth, Nantucket, Norfolk, Suffolk
Blizzard	March 1993	Statewide
Blizzard	January 1996	Statewide
Severe Storms, Flood	October 1996	Counties of Essex, Middlesex, Norfolk, Plymouth, Suffolk
Heavy Rain, Flood	June 1998	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
Severe Storms, Flood	March 2001	Counties of Bristol, Essex, Middlesex, Norfolk, Suffolk, Plymouth, Worcester
Snowstorm	March 2001	Berkshire, Essex, Franklin, Hampshire, Middlesex, Norfolk, Worcester
Snowstorm	February 2003	Statewide
Snowstorm	December 2003	Barnstable, Berkshire, Bristol, Essex, Franklin, Hampden, Hampshire, Middlesex, Norfolk, Plymouth, Suffolk, Worcester
Flooding	April 2004	Essex, Middlesex, Norfolk, Suffolk, Worcester
Snow	January 2005	Statewide
Hurricane Katrina	August 2005	Statewide
Severe Storms, Flooding	October 2005	Statewide
Severe Storms, Flooding	May 2006	Statewide
Severe Storm, Inland, Coastal Flooding	April 2007	Statewide
Severe Winter Storm	December 2008	Berkshire, Bristol, Essex, Franklin, Hampden, Hampshire, Middlesex, Suffolk, Worcester
Severe Storms, Flooding	December 2008	Statewide
Severe Storms, Flooding	March/April 2010	Bristol, Essex, Middlesex, Suffolk, Norfolk, Plymouth, Worcester
Severe Winter Storm, Snowstorm	January 2011	Berkshire, Essex, Hampden, Hampshire, Middlesex, Norfolk, Suffolk
Severe Storm, Snowstorm	October 2011	Berkshire, Franklin, Hampden, Hampshire, Middlesex, Worcester
Severe Winter Storm, Snowstorm and Flooding	February, 2013	Statewide

Disaster Name	Date of Event	Declared Areas
Severe winter storm, snowstorm, and flooding	April 2015	Barnstable, Bristol, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth, Suffolk, Worcester
Severe winter storm and Snowstorm	March 2018	Essex, Middlesex, Norfolk, Suffolk, Worcester

Source: MA Hazard Mitigation and Climate Adaptation Plan, 2018

FEMA FUNDED MITIGATION PROJECTS

The City of Somerville has received funding from FEMA for one mitigation projects under the Hazard Mitigation Grant Program (HMGP). This project totaled $40, 000 with $28,445 covered by FEMA grants and $10,000 by local funding. The project is summarized in Table 3 below.

Table 3. FEMA-Funded Mitigation Projects

Project Title (Funding Source)	Scope of Work	Total Cost	Federal Funding	Local Funding
EM Building Retrofitting	Install backwater valve in sewer main that services Somerville's Public Safety Building; install emergency pumping system.	$40,000.00	$28,445.67	$10,000.00

(Source: database provided by MEMA)

COMMUNITY PROFILE

Located in the Boston Basin coastal plain, the City of Somerville is bounded to the north by the Mystic River and the City of Medford and the City of Everett; to the west by the Alewife Brook and the Town Arlington; and to the east and south by the cities of Boston and Cambridge.

Physical topography is a defining characteristic of Somerville: seven hills create drainage divides and transportation corridors, while lowlands and filled marshlands have influenced historical and current development patterns. Although Somerville is part of a vast regional network of natural resources and open space, the city retains its own uniquely urban character, distinct from the communities surrounding it.

The City has a strong independent and entrepreneurial identity. From the City's beginnings, it has been a gateway for immigrants, a haven for creative thinkers, and a place where families of all means can establish their homes. Somerville's residents turn the notion of the anonymous urban environment on its head, building and expanding connections between neighbors, business owners and civic leaders that are the envy of communities everywhere.

Transportation

Because of its proximity to the state's largest city and important waterways, Somerville has always been part of the greater regional transportation infrastructure. The City is served by several major transportation corridors including Route 16, Route 28, and Interstate 93, as well as by the MBTA Red and Orange Lines. An extension of the MBTA Green Line service is under construction and will serve Somerville with five new stations along the Fitchburg/South Acton commuter rail corridor. With the addition of these new MBTA stations, 85% of Somerville's population will have access to public transportation.

Water Supply and Wastewater Management

Somerville's water supply and sewage disposal systems are provided by the Massachusetts Water Resources Authority (MWRA). Water supplies are transported from the Quabbin and Wachusett Reservoirs in central Massachusetts by regional aqueducts and pipelines. The water is delivered to Somerville through seven MWRA master meters into the City's distribution system, which consists of 120 miles of pipes, laid mainly in the late 1880s to early 1900s, as well as valves, hydrants and service lines. This system delivers water to homes, businesses, and other facilities for drinking and other uses. There are no surface impoundments or other water sources within the city that are utilized for drinking water.

Sewer services consist of a series of sanitary/stormwater lines that convey effluent to a regional treatment plant at Deer Island, operated by the Massachusetts Water Resources Authority (MWRA). The city has approximately 165 miles of sewers – approximately 68 miles are combined sewers (handling both sewer and stormwater), approximately 62 miles are separate sanitary sewers, and approximately 35 miles are separate storm drains. The majority of Somerville's sewers were constructed in the latter part of the 19th century; consequently, aging infrastructure and increased demands burden the current system. Somerville has two active Combined Sewer Overflow (CSO) discharges – one at Alewife Brook Parkway near the Cambridge border (maintained by the City of Somerville) and one on the Mystic River in East Somerville (jointly maintained by the City of Somerville and MWRA). These CSOs discharge a combination of stormwater and wastewater effluent into the waterways when heavy rains exceed the system's capacity. The Alewife Brook CSO overflows an average of 12 times a year.

Population and Demographics

The City has a population of 81,045 in a land area if approximately 4.1 square miles. The population density, based on the current population, is approximately 19,767 people per square mile.

Race, Ethnicity, and Language

According to the 2019 American Community Survey, 33.2% of the city's population is non-white and 26.5% is foreign-born. This reflects Somerville's long-standing role as a gateway community for newcomers to the United States. Accordingly, 31.8% of Somerville residents speak a language other than English at home, and 12.1% speak English less than very well. There are more than 50 languages spoken in the city. The most commonly spoken foreign languages in Somerville are Portuguese and Spanish, respectively. Smaller yet significant populations of Haitian Creole, Italian, Chinese and Nepali speakers are also present.

Table 4. Somerville Characteristics

Population = 81,045

- 10% are under the age 15
- 9.5% are over age 65
- 31.8 % speak a language other than English at home
- 12.1% speak English less than very well
- 26.5 % are foreign-born
- 7.9% have a disability
- 16.4 % have no vehicle

Number of Housing Units = 36,269

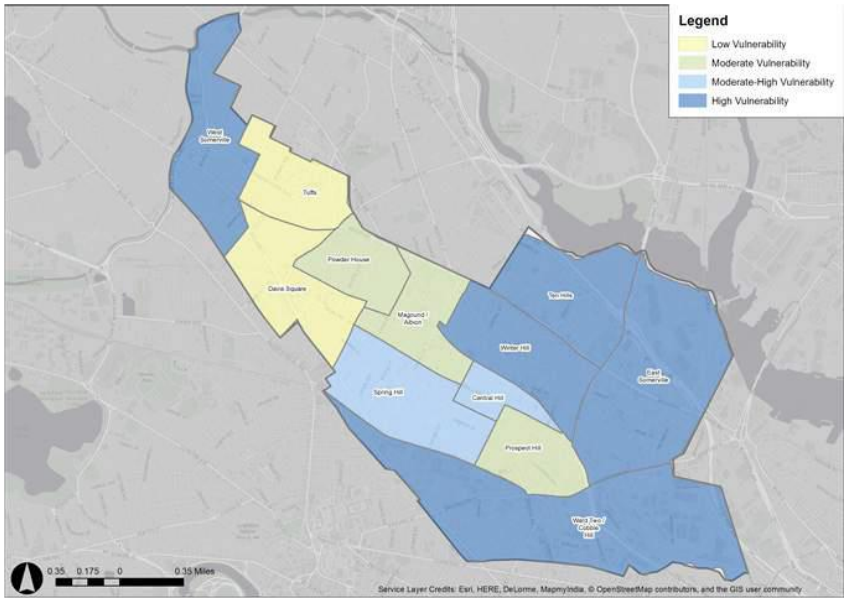
- 66.4% are renter-occupied housing units
- 80.2% of housing units were built prior to 1970

Source: U.S. Census, 2020; American Community Survey 2019

Vulnerable Populations

The neighborhoods of East Somerville and parts of Winter Hill have some of the lowest household incomes and the most diverse populations in Somerville. These neighborhoods have a large foreign born and non-English speaking population, and many recent immigrants from El Salvador and Brazil who live in multi-family dwellings. They are neighborhoods which have historically lacked amenities, including open space, and they meet Environmental Justice criteria. The Climate Change Vulnerability Assessment considered several demographic factors in defining vulnerable populations: age (elderly over 65 and children under 5), income, education, and limited English language proficiency. Figure 1 shows an overview of concentrations of vulnerable populations.

Figure 1. Vulnerable Populations by Neighborhood



Source: Somerville Climate Change Vulnerability Assessment, 2017

The City of Somerville has several unique characteristics to keep in mind while planning for natural hazards:

- Somerville has been proactive in addressing the impact of climate on natural hazards. The community is certified by the state as a Municipal Vulnerability Preparedness community, and has prepared a Climate Change Vulnerability Assessment, the Somerville Climate Forward Plan, Keep Cool Somerville, and an Urban Forest Management Plan.

- Somerville is an active member of the Metro Mayors Climate Task Force, a group of 15 urban core communities that collaborate on climate resilience initiatives locally and regionally.

- Somerville is located in the Mystic River watershed. The City collaborates with cities of Boston, Chelsea, Everett, Revere and Winthrop in the Resilient Mystic Collaborative, which prepared the Lower Mystic Regional Climate Assessment.

- Records from flooding in 2010 highlight that significant flood damage occurred throughout the city, with 67 disaster flood claims filed with FEMA, 100% of which were located outside the FEMA 1% chance flood zone.

- Flooding occurs in multiple locations, many of them related to MassDOT roadways and MBTA transit facilities, requiring collaboration between the City and these state agencies.

SECTION 3: PLANNING PROCESS & PUBLIC PARTICIPATION

MAPC employs a six-step planning process based on FEMA's hazard mitigation planning guidance focusing on local needs and priorities but maintaining a regional perspective matched to the scale and nature of natural hazard events and regional climate change. Public participation is a central component of this process, providing critical information about the local occurrence of hazards while also serving as a means to build a base of support for hazard mitigation activities. MAPC supports participation by the general public and other plan stakeholders through two public meetings, posting of the plan to the City's website, and invitations sent to neighboring communities, city boards and commissions, and other local or regional entities to review the plan and provide comment.

PLANNING PROCESS SUMMARY

The six-step planning process outlined below is based on the guidance provided by FEMA's Local Multi-Hazard Mitigation Planning Guidance. Public participation is a central element of this process, which attempts to focus on local problem areas and identify needed mitigation measures based on where gaps occur in the existing mitigation efforts of the municipality. In plan updates, the process described below allows staff to bring the most recent hazard information into the plan, including new hazard occurrence data, changes to a municipality's existing mitigation measures, and progress made on actions identified in previous plans.

Figure 2: Six-Step Planning Process

1. **Map the Hazards** – MAPC relies on data from a number of different federal, state, and local sources in order to map the areas with the potential to experience natural hazards. This mapping represents a multi-hazard assessment of the municipality and is used as a set of base maps for the remainder of the planning process. A particularly important source

of information is the knowledge drawn from local municipal staff on where natural hazard impacts have occurred. These maps can be found in Appendix B.

2. **Assess the Risks & Potential Damages** – Working with local staff, critical facilities, infrastructure, vulnerable populations, and other features are mapped and contrasted with the hazard data from the first step to identify those that might represent particular vulnerabilities to these hazards. Land use data and development trends are also incorporated into this analysis. In addition, MAPC develops estimates of the potential impacts of certain hazard events on the community. MAPC drew on the following resources to complete the plan:

   - City of Somerville, Keep Cool Somerville, 2021
   - City of Somerville, Urban Forest Management Plan, Draft, 2020
   - City of Somerville, Somerville Climate Forward Progress Report, 2020
   - City of Somerville, Somerville Climate Forward Progress Report, 2019
   - City of Somerville, Somerville Climate Forward, 2018
   - City of Somerville, Climate Change Vulnerability Assessment, 2017
   - City of Somerville, Open Space and Recreation Plan, 2016
   - Cit of Somerville, Sewer Division, Catch Basin Inspection, Cleaning, and Maintenance
   - City of Somerville Zoning Ordinances
   - City of Cambridge Climate Change Vulnerability Assessment
   - Climate Ready Boston, 2016
   - Blue Hill Observatory
   - Boston HIRA
   - FEMA, Flood Insurance Rate Maps for Middlesex County, MA, 2010
   - FEMA, Hazards U.S. Multi-Hazard (HAZUS-MH), 2021
   - FEMA, Local Mitigation Plan Review Guide, October 2011
   - Fourth National Climate Assessment, 2018
   - Massachusetts Office of Dam Safety, Inventory of Massachusetts Dams 2018
   - Massachusetts State Hazard Mitigation Plan, 2013
   - Massachusetts State Hazard Mitigation and Climate Adaptation Plan, 2018
   - Metropolitan Area Planning Council, GIS Lab, Regional Plans and Data
   - National Weather Service
   - Nevada Seismological Library
   - New England Seismic Network, Boston College Weston Observatory, http://aki.bc.edu/index.htm
   - NOAA National Centers for Environmental Information, http://www.ncdc.noaa.gov/
   - Northeast Climate Adaptation Science Center
   - Northeast States Emergency Consortium, http://www.nesec.org/
   - Resilient Mystic Collaborative, Lower Mystic Regional Climate Assessment, 2021
   - Tornado History Project
   - US Census, 2010 and American Community Survey 2017 5-Year Estimates
   - USGS, National Water Information System, http://nwis.waterdata.usgs.gov/usa/nwis

3. **Review Existing Mitigation** – Municipalities in the Boston Metropolitan Region have an active history in hazard mitigation as most have adopted flood plain zoning districts, wetlands protection programs, and other measures as well as enforcing the State building code, which has strong provisions related to hazard resistant building requirements. Many communities have started adopting regulations designed to promote climate resilience. All current municipal mitigation measures must be documented.

4. **Develop Mitigation Strategies** – MAPC works with the local municipal staff to identify new mitigation measures, utilizing information gathered from the hazard identification, vulnerability assessments, and the community's existing mitigation efforts to determine where additional work is necessary to reduce the potential damages from hazard events. Additional information on the development of hazard mitigation strategies can be found in Section 7.

5. **Plan Approval & Adoption** – Once a final draft of the plan is complete it is sent to MEMA for the state level review and, following that, to FEMA for approval. Typically, once FEMA has approved the plan the agency issues a conditional approval (Approval Pending Adoption), with the condition being adoption of the plan by the municipality. More information on plan adoption can be found in Section 9 and documentation of plan adoption can be found in Appendix D.

6. **Implement & Update the Plan** – Implementation is the final and most important part of any planning process. Hazard Mitigation Plans must also be updated on a five-year basis making preparation for the next plan update an important on-going activity. Section 9 includes more detailed information on plan implementation.

2016 PLAN IMPLEMENTATION & MAINTENANCE

The 2016 City of Somerville Hazard Mitigation Plan contained a risk assessment of identified hazards for the city and mitigation measures to address the risk and vulnerability from these hazards. Since approval of the plan by FEMA and local adoption progress has been made on implementation of the measures. The city has advanced a number of projects for implementation, including Somerville Avenue drainage improvements, installation of a new pump at the 137 Washington St. Bridge, drainage relief at Cedar Street and Hall Street, and drainage improvements on the Somerville Bike Path. Partially completed mitigation measures include Inner Belt Industrial Park drainage improvements, the Medford Street underpass, and Green Infrastructure installation on Somerville Avenue. In addition, the city completed a Climate Change Vulnerability Assessment and the Somerville Climate Forward Plan and has been certified by the state in the Municipal Vulnerability Preparedness program.

THE LOCAL HAZARD COMMUNITY PLANNING TEAM

MAPC worked with the local community representatives to organize a Local Hazard Mitigation Planning Team for Somerville. MAPC briefed the local representatives as to the desired composition of that team as well as the need for public participation in the local planning process.

The Local Hazard Mitigation Planning Team is central to the planning process as it is the primary body tasked with developing a mitigation strategy for the community. The local team was tasked with working with MAPC to set plan goals, provide information on the hazards that impact the city, existing mitigation measures, and helping to develop new mitigation measures for this plan update. The Local Hazard Mitigation Planning Team membership is listed below.

Chief Charles Breen	Fire Chief, Fire Dept.
Danielle O'Hearn	Lieutenant, Homeland Security, Fire Dept.; HMP Team Coordinator
Christopher Major	Assistant Chief, Fire Dept
Thomas E. Graney	Homeland Security Coordinator ,Fire Dept.
Charles Femino	Acting Chief, Police Dept
Timothy Mitsakis	Lieutenant, Police Dept
Scott Whalen	Sargent, Police Dept.
Sal Fusco	Sargent, Police Dept.
Brian Postlewaite	Director of Engineering
Oliver Sellers-Garcia	Director, Office of Sustainability and Environment
Vithal Deshpande	Environmental Coordinator, Office of Sustainability and Environment
Douglas Kress	Director of Health and Human Services
Jill Lathan	Director, Parks & Recreation; Acting Commissioner, Public Works Dept.
George Proakis	Executive Director, Strategic Planning and Community Development
Christine Blais	Acting Director, Office of Sustainability and Environment
Justin Kates	Director of Emergency Management

The Somerville Planning Board and Conservation Commission are the primary entities responsible for regulating development in city. Feedback was assured through the participation of the Director of Strategic Planning and Community Development and the Conservation Commission, which hosted a public meeting on the plan. In addition, MAPC, the State-designated regional planning authority for the Boston metropolitan region, works with all agencies that that regulate development in the region, including the listed municipal entities and state agencies, such as the Department of Transportation.

The Local Hazard Mitigation Planning Team met on the following dates: July 7, 2021, September 13, 2021, and November 15, 2021. The purpose of the meetings was to introduce the Hazard Mitigation planning program, consider climate impacts, review, and update hazard mitigation goals, and to gather information on local hazard mitigation issues and sites or areas related to these. Later meetings focused on verifying information gathered by MAPC staff and discussion of existing mitigation practices, the status of mitigation measures identified in the 2016 Hazard Mitigation Plan, and potential new or revised mitigation measures. The agendas for these meetings are included in Appendix A.

PUBLIC MEETINGS

Public participation in the hazard mitigation planning process is important, both for plan development and for later implementation of the plan. Residents, business owners, and other community members are an excellent source for information on the historic and potential impacts of natural hazard events and particular vulnerabilities the community may face from these hazards. Their participation in this planning process also builds understanding of the concept of hazard mitigation and climate impacts, potentially creating support for mitigation actions taken in the future to implement the plan. To gather this information and educate residents on hazard mitigation, the city hosted two public meetings, one during the planning process and one after a complete draft plan was available for review.

The public had an opportunity to provide input to the Somerville hazard mitigation planning process during a public meeting held on October 26, 2021, hosted by the Conservation Commission. The draft plan update was presented at a public meeting hosted by the Hazard Mitigation Team on December 1, 2021. Both meetings were publicized in accordance with the Massachusetts Public Meeting Law. Meeting notices were also circulated in four other languages, Haitian Creole, Nepali, Portuguese, and Spanish. The meeting agendas and public meeting notices are found in Appendix C.

LOCAL STAKEHOLDER INVOLVEMENT

The local Hazard Mitigation Planning Team reached out to local stakeholders that might have an interest in the Hazard Mitigation Plan including neighboring communities, agencies, businesses, nonprofits, and other interested parties. Notice was sent to the following organizations and neighboring municipalities inviting them to review the Hazard Mitigation Plan and submit comments to the city. In addition, meetings were advertised in the local press, on the city website, and through City social media platforms. The following organizations, departments, and neighboring communities received invitations to attend the public meeting:

- City of Boston
- City of Cambridge
- City of Everett
- City of Medford
- Town of Arlington
- Somerville Chamber of Commerce
- Cataldo Ambulance
- Cambridge Health Alliance
- Somerville Council on Aging
- Eversource
- Tufts University Emergency Management
- Somerville Public School Dept.
- Triumvirate Environmental
- Chief of Staff to Mayor
- Somerville Traffic & Parking Dept.
- Somerville Board of Councilors
- Somerville Housing Department
- Somerville Mobility Department
- Somerville Parks and Recreation Dept.
- Somerville Communications Department

See Appendix C for public meeting notices and agendas. The draft Somerville Hazard Mitigation Plan 2022 Update was posted online for the second public meeting. Members of the public could

access the draft document and submit comments or questions to the city. One public comment was received (see Appendix E). As a result, an additional local flooding site at Lake Street was added to the plan.

CONTINUING PUBLIC PARTICIPATION

Following the adoption of the plan update, the Hazard Mitigation Team will continue to provide residents, businesses, and other stakeholders the opportunity to learn about the hazard mitigation planning process and to contribute information that will update the city's understanding of local hazards. As updates and a review of the plan are conducted by the Hazard Mitigation Team, these will be placed on the City's web site, and any meetings of the Team will be publicly noticed in accordance with city and state open meeting laws.

PLANNING TIMELINE

July 7, 2021	1st Meeting of the Somerville Local Hazard Mitigation Team
September 13, 2021	2nd Meeting of the Somerville Local Hazard Mitigation Team
October 26, 2021	First Public Meeting held virtually
November 15, 2021	3rd Meeting of the Somerville Local Hazard Mitigation Team
December 1, 2021	Second Public Meeting held virtually
December 16, 2021	Draft Plan Update submitted to MEMA
TBD	Draft Plan Update submitted to FEMA
TBD	Notice of Approvable Pending Adoption sent by FEMA
TBD	Plan Adopted by the City of Somerville
TBD	FEMA final approval of the plan for 5 years

POST-PLAN APPROVAL: IMPLEMANTATION AND PLAN UPDATE TIMELINE

Mid-2024	Conduct Mid-Term Plan Survey on Progress
2024	Seek FEMA grant to prepare next plan update
2025	Begin process to update the plan
2026	Submit Draft 2026 Plan Update to MEMA and FEMA
2026	FEMA approval of 2026 Plan Update

SECTION 4: RISK ASSESSMENT

The risk assessment analyzes the potential natural hazards that could occur within the City of Somerville as well as the relationship between those hazards and current land uses, potential future development, and critical infrastructure. This section also includes a vulnerability assessment that estimates the potential damages that could result from certain large-scale natural hazard events. In order to update Somerville's risk assessment, MAPC gathered the most recently available hazard and land use data and met with City staff to identify changes in local hazard areas and development trends. MAPC also used FEMA's damage estimation software, HAZUS.

With the adoption of the Hazard Mitigation and Climate Adaptation Plan 2018 (SHMCAP), Massachusetts became the first state to integrate climate projections in a state hazard mitigation plan. Following the state model, the projected impacts of our warming climate on natural hazards are integrated throughout the risk assessment. Key impacts include rising temperatures, which in turn affect precipitation patterns, sea level, and extreme weather.

> *"Global climate is changing rapidly compared to the pace of natural variations in climate that have occurred throughout Earth's history. Global average temperature has increased by about 1.8°F from 1901 to 2016, and observational evidence does not support any credible natural explanations for this amount of warming; instead, the evidence consistently points to human activities, especially emissions of greenhouse or heat-trapping gases, as the dominant cause."*
>
> Fourth National Climate Assessment, 2018 (Chapter 2-1)

CLIMATE CHANGE OBSERVATIONS AND PROJECTIONS

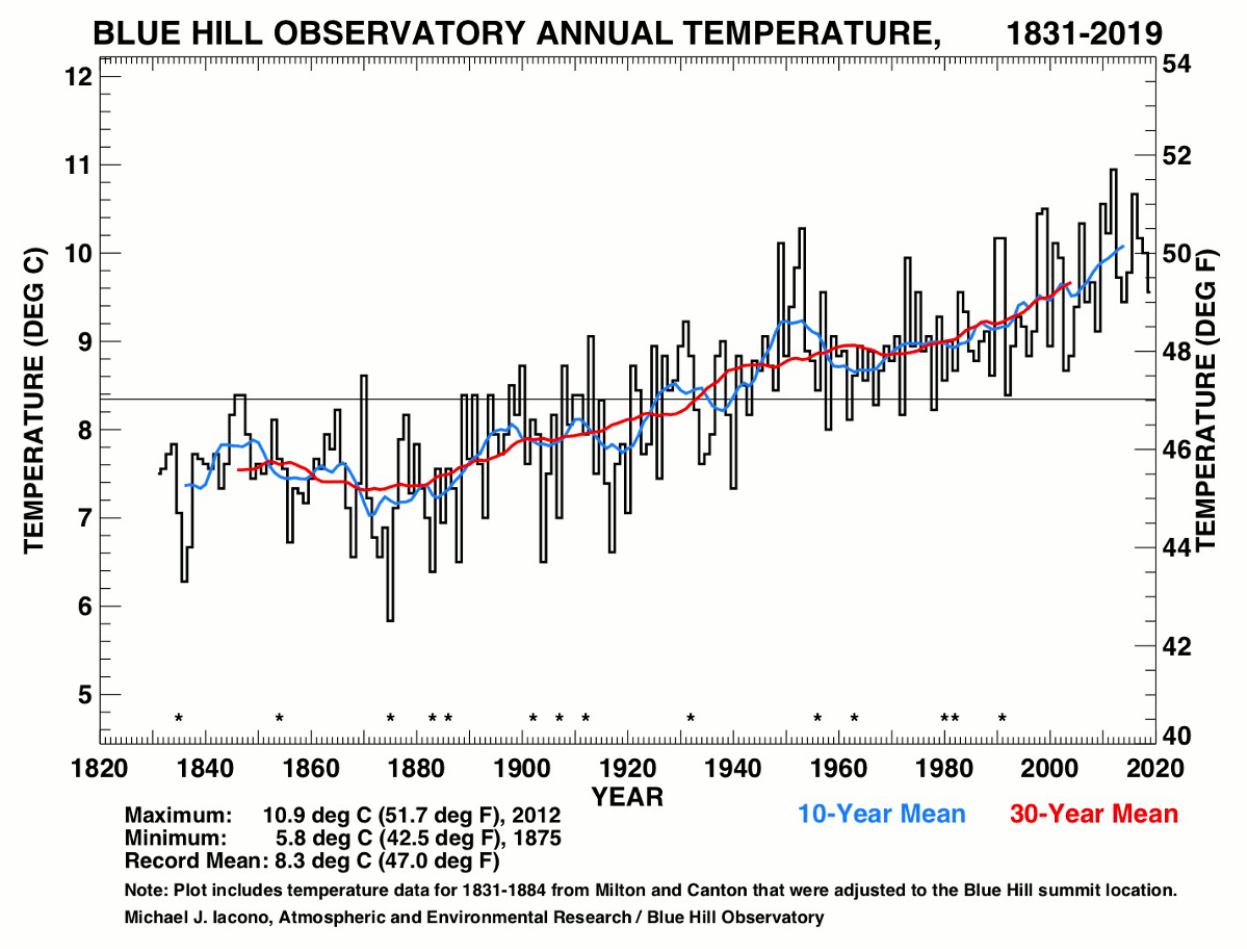
Climate change observations come from a variety of data sources that have measured and recorded changes in recent decades and centuries. Climate change projections, however, predict future climate impacts and, by their nature, cannot be observed or measured. As a result of the inherent uncertainty in predicting future conditions, climate projections are generally expressed as a range of possible impacts.

Temperature

Our climate has always been regulated by gases, including carbon dioxide, methane, and nitrous oxide, which blanket the earth. These gases trap heat that would otherwise be reflected out to space; without them our planet would be too cold to support life. We refer to these gases as "greenhouse gases" (GHGs) for their heat trapping capacity. The combustion of fossil fuels, our primary energy source in the age of industrialization, releases GHGs into the atmosphere. In the past century, human activity associated with industrialization has contributed to a growing concentration of GHGs in our atmosphere.

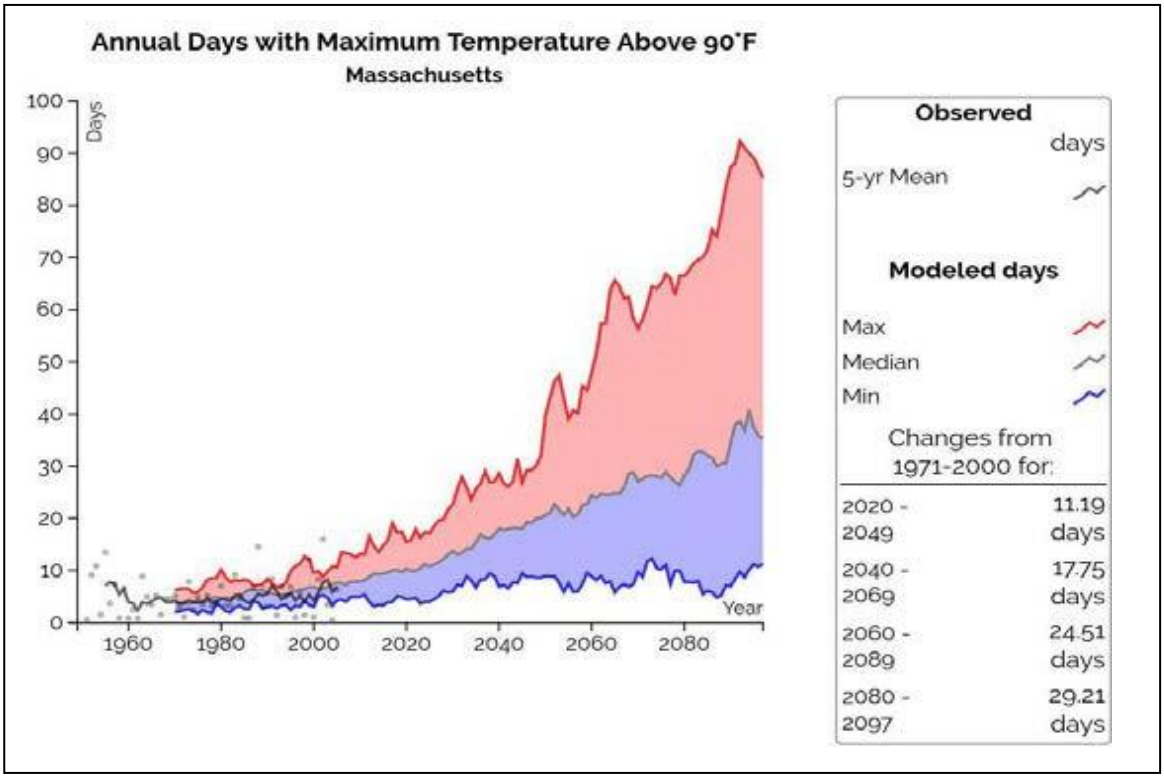
Records from the Blue Hill Observatory in Milton, MA show that average temperatures (30-year mean) have risen approximately 3 degrees (F) in the almost 200 years since record keeping began in 1831.

Figure 3: Observed Increase in Temperature



Climate projections include an increase in average temperature and in the number of extreme heat days. Extreme cold days are projected to decrease in number. The Northeast Climate Adaptation Science Center (NECASC) projects average temperatures in Massachusetts will increase by 5 degrees F by mid-century and nearly 7 degrees F by the end of the century. Figure 4 shows the NECASC range of projections for increases in the number of days over 90 degrees annually.

Figure 4: Projected Increase in Annual Days Over 90 Degrees F



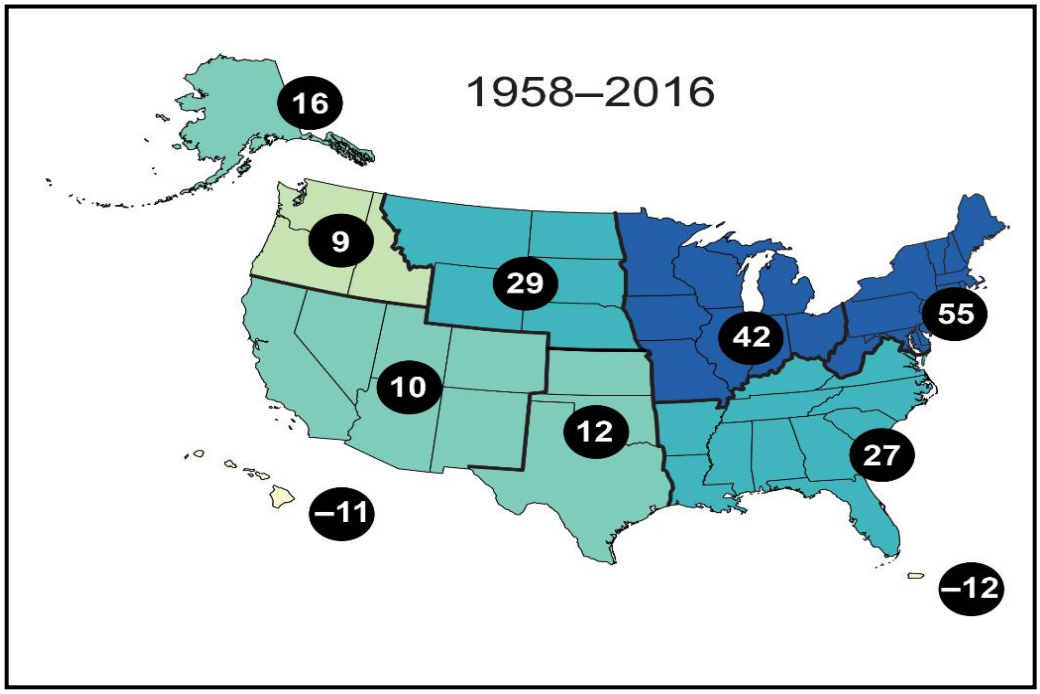
Source: Northeast Climate Adaptation Science Center

Precipitation Patterns

Annual precipitation in Massachusetts has increased by approximately 10% in the fifty-year period from 1960 to 2010 (MA Climate Adaptation Report, 2011). Moreover, there has been a significant increase in the frequency and intensity of large rain events. For the Northeast US, according to the Fourth National Climate Assessment 2018, in the past sixty years there has been a 55% increase in the amount of annual precipitation that falls in the top 1% of storm events (Figure 5). Changes in precipitation are fueled by warming temperatures which increase evaporation and, therefore, the amount of water vapor in the air.

Total annual precipitation in Massachusetts is projected to increase by 1 to 6 inches by mid-century, and by 1.2 to 7.3 inches by the end of this century (SHMCAP p. 2-22). The Fourth National Climate Assessment predicts that the pattern of increasing frequency and intensity of extreme rain events will continue. By 2070 to 2099, (relative to 1986 to 2015) they project a 30-40% increase in total annual precipitation falling in the heaviest 1% of rain events (Figure 6).

Figure 5: Observed Change in Total Annual Precipitation Falling in the Heaviest 1% of Events

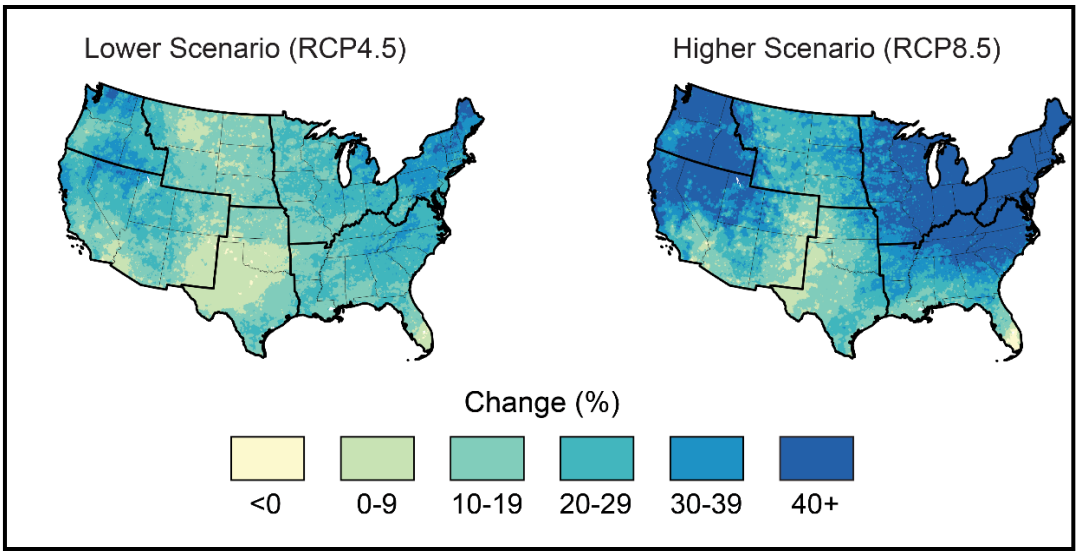


Source: Fourth National Climate Assessment, 2018

Numbers circled in black indicate % change.

Despite overall increasing precipitation, more frequent and significant summer droughts are also a projected consequence of climate change. This is due to projections that precipitation will increase in winter and spring and decrease slightly in the summer and, a result of earlier snow melt, and higher temperatures that will reduce soil moisture.

Figure 6: Projected Change in Total Annual Precipitation Falling in the Heaviest of 1% of Events for 2070-2099

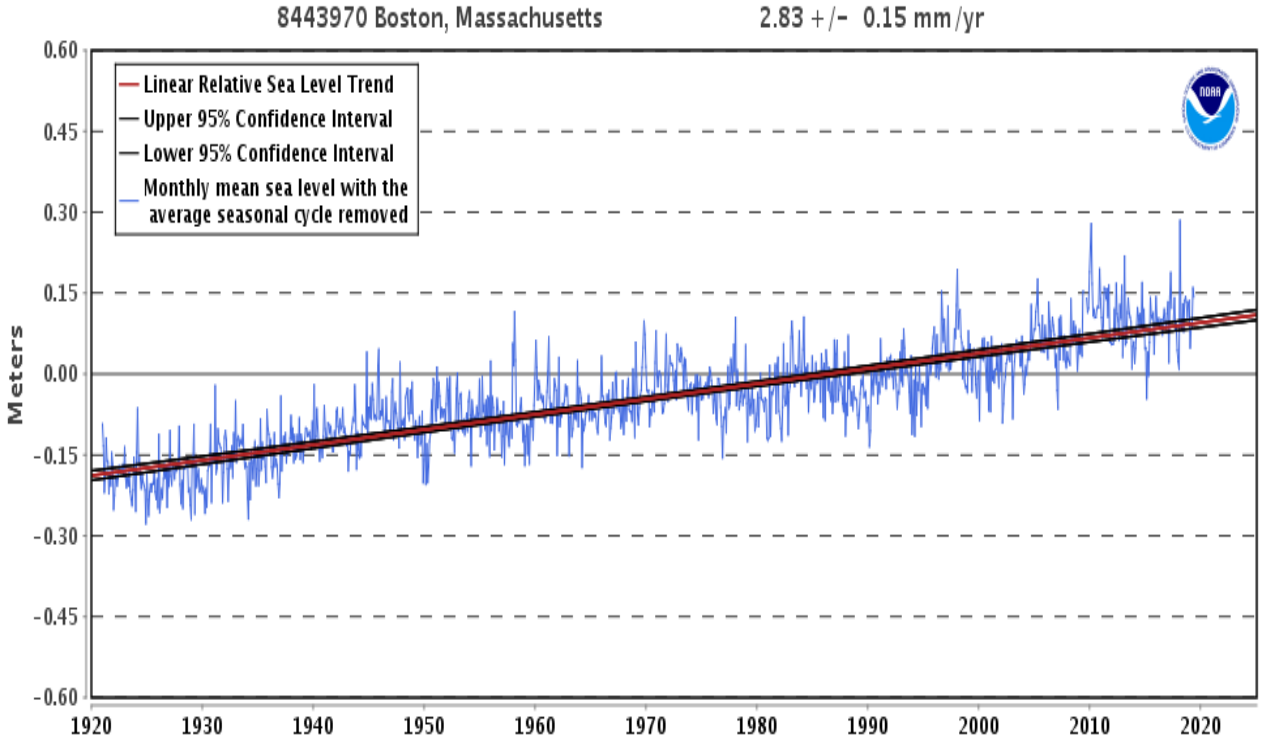


Source: Fourth National Climate Assessment, 2018

Sea Level Rise

Records from the Boston Tide Station show nearly one foot of sea level rise in the past century (Figure 7). Warming temperatures contribute to sea level rise in three ways. First, warm water expands to take up more space. Second, rising temperatures are melting land-based ice which enters the oceans as melt water. A third, quite minor, contributor to sea level rise in New England is not related to climate change. New England is still experiencing a small amount of land subsidence (drop in elevation) in response to the last glacial period.

Figure 7: Observed Increase in Sea Level Rise



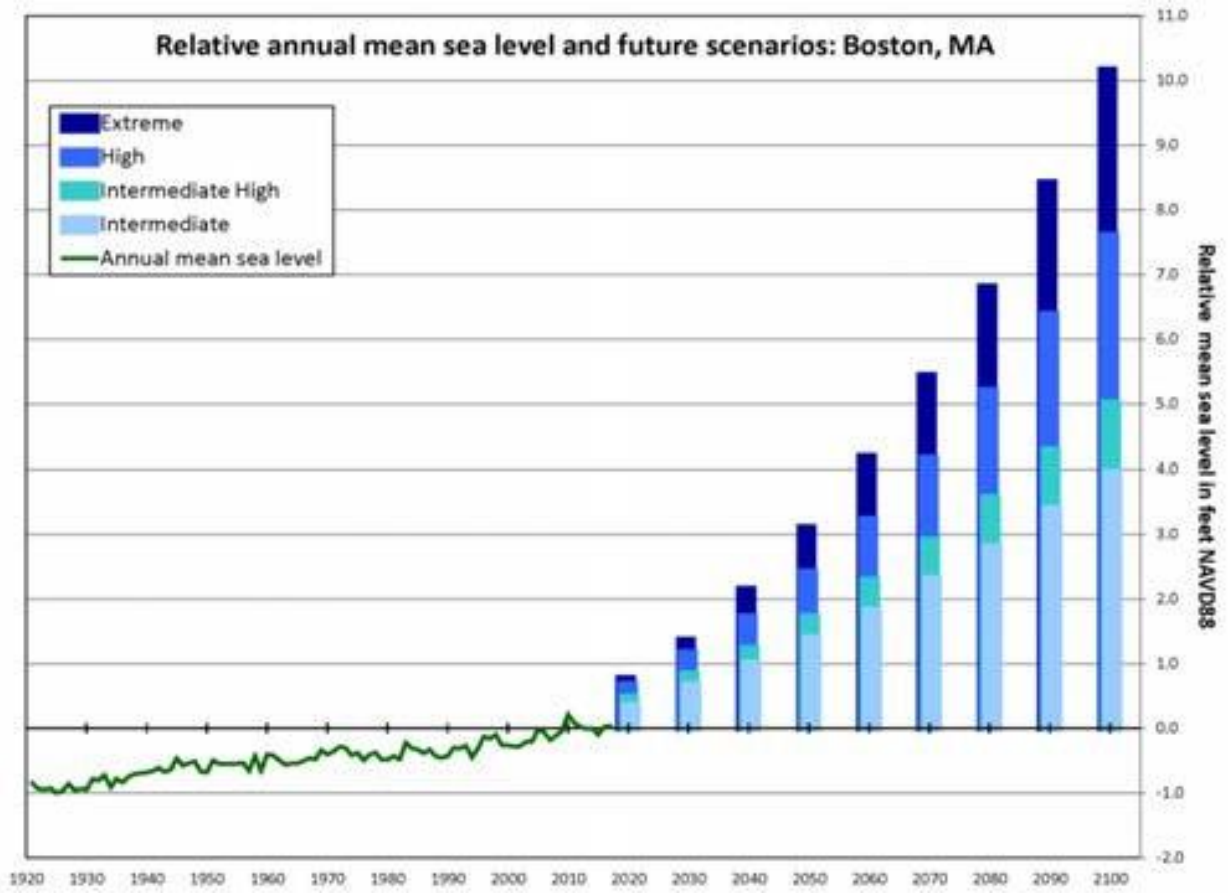
Source: NOAA

Projections of sea level rise through 2100 vary significantly depending on future greenhouse gas emissions and melting of land-based glaciers. Currently sea level is rising at an increasing rate. Figure 8 shows the recent rate of sea level rise, and a range of sea level rise scenarios. Projections for 2100 range from 4 feet to 10 feet. With ten feet representing the most extreme scenario. For 2050, the projections range approximately 1.5 to 3 feet.

Following the outline of the Massachusetts State Hazard Mitigation and Climate Adaptation Plan (SHMCAP), this local hazard mitigation plan organizes consideration of natural hazards based on their relationship to projected climate changes. Table 5 below, from the SHMCAP, summarizes the natural hazards reviewed in this plan, climate interactions, and expected impacts.

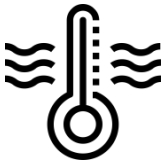
Figure 8: Recent and Projected Increase in Sea Level Rise

1



Source: SHMCAP

Table 5: Climate Change and Natural Hazards

Primary Climate Change Interaction	Natural Hazard	Other Climate Change Interactions	Representative Climate Change Impacts
 **Changes in Precipitation**	Inland Flooding	Extreme Weather	Flash flooding, urban flooding, drainage system impacts (natural and human-made), lack of groundwater recharge, impacts to drinking water supply, public health impacts from mold and worsened indoor air quality, vector-borne diseases from stagnant water, increased potential for loss of life, episodic drought, changes in snow-rain ratios, changes in extent and duration of snow cover, degradation of stream channels and wetland
	Drought	Rising Temperatures, Extreme Weather	
	Landslide	Rising Temperatures, Extreme Weather	
 **Sea Level Rise**	Coastal Flooding	Extreme Weather	Increase in tidal and coastal floods, storm surge, coastal erosion, marsh migration, inundation of coastal and marine ecosystems, loss of wetlands
	Coastal Erosion	Extreme Precipitation	
	Tsunami	Rising Temperatures	
 **Rising Temperatures**	Average/Extreme Temperatures	N/A	Shifting in seasons (longer summer, early spring, including earlier timing of spring peak flow), increase in length of growing season, increase of invasive species, increase in vector-borne illnesses (West Nile, Zika, EEE), ecosystem stress, energy brownouts from higher energy demands, more intense heat waves, public health impacts from high heat exposure and poor outdoor air quality, increased potential for loss of life, drying of streams and wetlands, eutrophication of lakes and ponds
	Wildfires	Changes in Precipitation	
	Invasive Species	Changes in Precipitation, Extreme Weather	
 **Extreme Weather**	Hurricanes/Tropical Storms	Rising Temperatures, Changes in Precipitation	Increase in frequency and intensity of extreme weather events, resulting in greater damage to natural resources, property, and infrastructure, as well as increased potential for loss of life
	Severe Winter Storm / Nor'easter		
	Tornadoes		
	Other Severe Weather (Strong Wind & Precipitation)		
Non-Climate-Influenced Hazards	Earthquake	Not Applicable	There is no established correlation between climate change and this hazard

OVERVIEW OF HAZARDS AND IMPACTS

Table 6 summarizes the frequency and severity of hazard risks for Massachusetts and Somerville. The Massachusetts assessment is based on the State Hazard Mitigation Plan. The statewide assessment was modified to reflect local conditions in Somerville using the definitions for hazard frequency and severity listed below.

Table 6: Hazards Risk Summary

Hazard	Frequency		Severity	
	Massachusetts	Somerville	Massachusetts	Somerville
Flooding	High	High	Serious	Serious
Extreme Temperatures	Medium	High	Minor	Serious
Nor'easters	High	High	Serious	Serious
Winter storms/blizzards	High	High	Minor	Minor
Thunderstorms	High	High	Minor	Minor
Hurricanes/Tropical Storms	Medium	Medium	Serious	Serious
Ice storms	Medium	Medium	Minor	Minor
Drought	Low	Medium	Minor	Minor
Earthquakes	Very Low	Very Low	Extensive	Extensive
Tornadoes	Medium	Very Low	Serious	Serious
Dam failures	Very Low	Very low	Serious	Serious
Brush fires	Medium	Very Low	Minor	Minor
Landslides	Low	Very Low	Minor	Minor

Source: Massachusetts State Hazard Mitigation Plan, modified to reflect conditions for Somerville

Frequency Categorization
Very low: events that occur less frequently than once in 100 years (Less than 1% per year)
Low: events that occur from once in 50 years to once in 100 years (1% to 2% per year)
Medium: events that occur from once in 5 years to once in 50 years (2% to 20% per year)
High: events that occur more frequently than once in 5 years (Greater than 20% per year)

Severity Categorization
Minor: Limited and scattered property damage; limited damage to public infrastructure and essential services not interrupted; limited injuries or fatalities.
Serious: Scattered major property damage; some minor infrastructure damage; essential services are briefly interrupted; some injuries and/or fatalities.
Extensive: Widespread major property damage; major public infrastructure damage (up to several days for repairs); essential services are interrupted from several hours to several days; many injuries and/or fatalities.
Catastrophic: Property and public infrastructure destroyed; essential services stopped; numerous injuries and fatalities

CHANGING PRECIPITATION PATTERNS

INLAND FLOODING

Inland flooding is generally caused by hurricanes, nor'easters, severe rainstorms, and thunderstorms. Nor'easters can occur at any time of the year, but they are most common in winter. Hurricanes are most common in the summer and early fall. Large rainstorms can occur year-round. Climate change has the potential to exacerbate these issues over time due to increasing extreme rainfall events. Increase in average annual rainfall may also lead to more incidents of basement flooding caused by high seasonal groundwater levels.

Flooding was the most prevalent serious natural hazard identified by local officials in Somerville. Inland flooding can be associated with overflowing rivers and streams, but more commonly in Somerville flooding is related to stormwater associated with impervious surfaces and stormwater infrastructure. Somerville is subject to two kinds of inland flooding: inland/riverine flooding where the rate of precipitation and/or amount of stormwater runoff overwhelms the capacity of natural or structured drainage systems, and urban flooding in which precipitation causes the water table to rise and leads to flooding of low-lying areas such as streets and basements. These types of flooding are often combined as storm events lead to large amounts of draining stormwater, which can be blocked by elements of the built environment and can be backed up when drainage locations (ponds, streams, etc.) are at or above capacity. It should be noted that Somerville is also subject to coastal flooding; see the section below "Coastal Flooding/Sea Level Rise.

Somerville is divided into two major watersheds, the Mystic River and Charles River. A number of smaller brooks and waterways have flooded in the past, most notable of these being Alewife Brook. Stream culverting and development have severely altered the natural flow of water in Somerville. Stormwater drainage from developed areas occurs primarily through the manmade system of stormwater infrastructure.

Drainage System Overview

The majority of Somerville's flooding problems are associated with the City's drainage system and the filling or channeling of natural water resource areas.

There are a variety of issues that affect the drainage system in the City. In some cases, the system is served by older infrastructure that has been impacted by additional or increased development and does not have the necessary capacity to accommodate the resulting runoff. There are instances where waterways serve as part of the drainage system, such as along Alewife Brook, but these can become restricted or blocked due to siltation or branches that have fallen into the open channel. Lastly, debris from roadways or from residents dumping (e.g., lawn clippings, raked leaves and other yard waste) have blocked pipes and culverts which has resulted in flooding of homes and public ways.

Some of the City's flooding problems are related to aging wastewater infrastructure. The majority of Somerville sewers were built over 125 years ago; nearly one-half are combined sewers, carrying both stormwater and household waste in severely aging, undersized pipes. Somerville's existing sewer system was not designed to handle today's high levels of stormwater runoff. More streets and paved parking lots exist presently than at the end of the 19th century when the sewers were built. These impervious surfaces exacerbate the effects of a storm as the runoff water is unable to filter into the ground and is quickly moved off-site to the nearest drains, and then into the sewer system. East Somerville has the largest area of impervious surface in the city, and also the greatest drainage troubles.

East Somerville's drainage problems are largely caused by the filling of the Millers River which originally served as the city's natural outlet to the Charles River. The "Main Drain," the backbone of Somerville's sewer system and CSOs, is aging and is undersized for the current magnitude of the city's needs. This combined sewer was built in 1873 and manages two-thirds of the city's present-day land-area water flows.

Somerville's combined sewage system is largely land-locked within the city with little to no drainage to other systems or natural water bodies. Additional challenges are created by legacy drainage issues on MBTA property adjacent to the Boston Engine Terminal (BET). Those challenges have a ripple effect throughout the eastern portion of Somerville.

Previous Occurrences and Extent of Flooding

There have been a number of major floods that have affected the Metro Boston region over the last fifty years. Significant historic flood events in Somerville have included:

- March 1968
- The blizzard of 1978
- January 1979
- April 1987
- October 1991 ("The Perfect Storm")
- October 1996
- June 1998
- March 2001
- April 2004
- May 2006
- April 2007
- March 2010

The best available local data on the previous occurrences of flooding are from the NOAA National Centers for Environmental Information, which are provided by county. Somerville is part of Middlesex County, for which historic flood events from 2010 through 2020 were compiled and are summarized in Table 7. Middlesex County experienced 49 flood events from 2010 through 2020. No deaths or injuries were reported, and the total reported property damage was $36.5 million dollars. Nearly all of the damage is attributed to the storm events of March 2010. This is an average of 4.4 flood events each year. Measures of flooding severity include river forecasts of minor, moderate, or severe flooding.

Table 7: Middlesex County Flood Events, 2010 through 2021

Date	Deaths	Injuries	Property Damage	
3/14/2010	0	0	26,430,000	
3/29/2010	0	0	8,810,000	
4/1/2010	0	0	0	
8/28/2011	0	0	5000	
10/14/2011	0	0	0	
6/8/2012	0	0	0	
6/23/2012	0	0	15000	
7/18/2012	0	0	5000	
10/29/2012	0	0	0	
6/7/2013	0	0	0	
7/1/2013	0	0	0	
7/23/2013	0	0	0	
9/1/2013	0	0	10000	
3/30/2014	0	0	35000	
3/30/2014	0	0	0	
7/27/2014	0	0	0	
8/31/2014	0	0	0	
10/22/2014	0	0	20000	
10/23/2014	0	0	0	
12/9/2014	0	0	35000	
5/31/2015	0	0	0	
8/4/2015	0	0	0	
8/15/2015	0	0	125000	
9/30/2015	0	0	0	
4/6/2017	0	0	0	
6/27/2017	0	0	1000	
7/12/2017	0	0	1000000	
7/18/2017	0	0	0	
8/2/2017	0	0	5000	
10/25/2017	0	0	0	
10/30/2017	0	0	0	
1/12/2018	0	0	0	
1/13/2018	0	0	0	
4/16/2018	0	0	0	
6/25/2018	0	0	15000	
8/8/2018	0	0	35000	
8/12/2018	0	0	30000	

8/17/2018	0	0	0	
10/29/2018	0	0	0	
11/3/2018	0	0	0	
11/10/2018	0	0	0	
7/6/2019	0	0	0	
8/7/2019	0	0	300	
9/2/2019	0	0	0	
6/21/2020	0	0	0	
6/28/2020	0	0	5000	
7/23/2020	0	0	0	
9/10/2020	0	0	3000	
07/09/2021	0	0	0	
TOTAL	0	0	$36,584,300	

Source: NOAA, National Centers for Environmental Information

The vulnerability analysis conducted by MAPC using FEMA's HAZUS-US model estimates a range of damages from flooding in Somerville from $127.3 million for a 100-year storm to $142.2 million for a 500-year storm (see Table 34).

The Storms of 2010

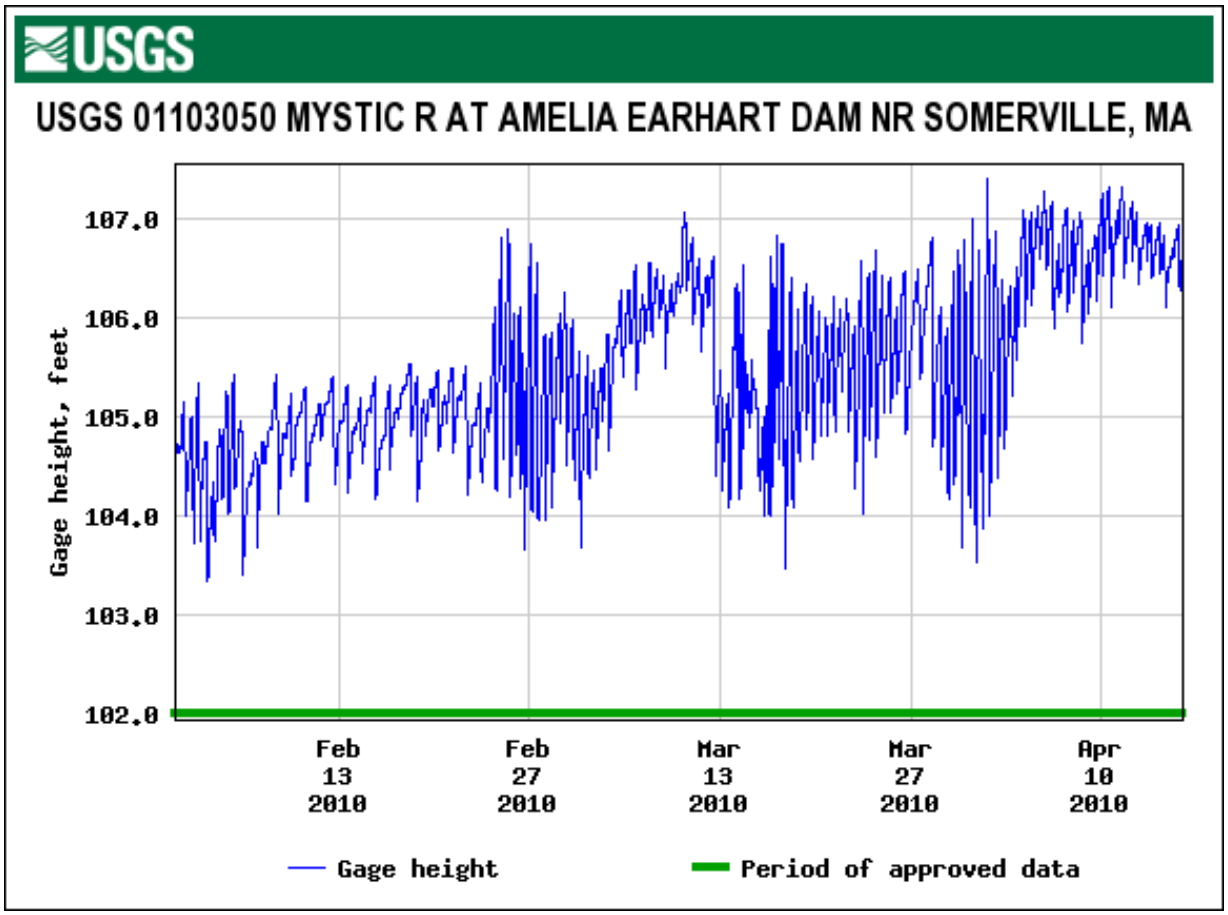
The most severe recent flooding occurred during the major storms of March 2010. The Blue Hill Observatory recorded 17.7 inches of rain from three storms in the 19 days from March 13 to 31. The weather pattern that caused these floods consisted of early springtime prevailing westerly winds that moved three successive storms, combined with tropical moisture from the Gulf of Mexico, across New England. Torrential rainfall lasting ten days caused March 2010 to be the wettest month on record.

One indication of the extent of flooding is the level of flow in the Mystic River during this record flood. Based on USGS gage height data, Figure 9 below shows that Mystic River at the Amelia Earhart Dam exceeded 107 feet after the first storm on March 10, and again after the second storm on March 31. The cumulative impact of multiple storms kept river levels high into April.

The historic March 2010 rainstorms fit the profile of a type of event expected to increase in frequency as the climate warms. That is, significant precipitation, falling in late winter as rain rather than snow, on ground saturated with snow melt, and while vegetation is still dormant.

The March 2010 storms were a federally declared disaster making federal assistance available to residents who did not carry flood insurance. Based on the claims, Somerville experienced significant flood damage, with 67 disaster claims. All of the claims were located *outside* of FEMA Special Flood Hazard Areas, and most were not associated with waterways or wetlands. This is not unusual in urbanized areas. See Map 3 in Appendix B for claim locations.

Figure 9: USGS Mystic River Gage Height, March 2010 Storms



Source: USGS National Water Information System

Locally Identified Areas of Flooding

Information on flood hazard areas was taken from two sources. The first is the National Flood Insurance Rate Maps (FIRM). The FIRM flood zones are shown on Map 3 in Appendix B. The Flood Insurance Rate Map zone definitions are shown below:

Zones A1-30 and AE: Special Flood Hazard Areas subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods. Base Flood Elevations are shown within these zones.

Zone A: Special Flood Hazard Areas subject to inundation by the 1-percent-annual-chance flood event are determined using approximate methodologies. Because detailed hydraulic analyses are not performed, no Base Flood Elevations or depths are shown.

Zone AO: Special Flood Hazard Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are

between one and three feet. Average flood depths derived from detailed hydraulic analyses are shown in this zone.

Zone B and X (shaded): Zones where the land elevation as been determined to be above the Base Flood Elevation, but below the 500-year flood elevation. These zones are not Special Flood Hazard Areas.

Zones C and X (unshaded): Zones where the land elevation has been determined to be above both the Base Flood Elevation and the 500-year flood elevation. These zones are not Special Flood Hazard Areas

The second source of flooding information was the local Hazard Mitigation Team. The Locally Identified Areas of Flooding listed in Table 8 were identified by City staff as areas where flooding is known to occur. These areas do not necessarily coincide with the flood zones from the FIRM maps. They may be areas that flood due to inadequate drainage systems or other local conditions rather than location within a flood zone. The numbers correspond to the numbers on Map 8, "Locally Identified Hazard Areas."

Table 8: Locally Identified Areas of Flooding

Map ID	Name	Description
1	Brickbottom	Located in the southeastern section of the city, the area is primarily impervious surfaces and during large rain events, the drainage system can back up leading to ponding and flooding. A pump station is currently in design that will resolve flooding in the greater Union Square area, including Brickbottom, in the next 5 years.
2	Lincoln Park	Open field behind school facility with some low-lying areas that can flood during large rain events. Since the 2016 plan this has been reconstructed with a storm water detention system, which alleviated flooding in park and a partially in the neighborhood, but the neighborhood still floods annually. The area is now part of a city-wide drainage analysis to identify options to reduce flooding (including Lincoln Park and much of Ward 2).
3	Public Safety Building	The existing Emergency Operations Center, Fire and Police facilities are vulnerable to flooding. The City is designing a new Public Safety facility at a different site that is not subject to flooding; completion is expected in about 5 years.
4	Cedar Street & Hall Street	Since the 2016 plan flooding has been resolved by separating the storm and sanitary sewers and substantially upsizing the storm drain.
5	Somerville Community Path	Low point along the Somerville Community Path where there is limited drainage and ponding has been known to occur. Since the 2016 plan flooding in the western half was resolved by new drainage system. The

		eastern half between Willow and Lowell still floods on a regular basis and is a focus area in the city-wide drainage analysis.
6	Tannery Brook	Area of residential structures where there has been known flooding.
7	Simpson Ave–Cady Ave–Broadway	Low lying elevation along street corridor that can be flooded due to heavy rain and drainage issues.
8	Beacon Street	Corridor where there has been historical flooding due to drainage issues. Since the 2016 plan the City reconstructed the corridor, which included minor stormwater improvements, so flooding is less severe, but not necessarily resolved.
9	Medford Street Underpass	Low point along roadway under the Fitchburg/South Acton commuter rail where flooding has occurred during large rain events.
10	Washington Street Underpass	Low point along roadway under the Fitchburg/South Acton commuter rail where flooding has occurred during large rain events. Since the 2016 plan work has been underway by the MBTA to reconstruct the pump station as part of the Green Line Extension project. The old pumps were removed and in the meantime, they've been using temporary pumps. Within a year, the new pumps will be in place, which will resolve flooding at this site.
11	Route 28 Underpass	Low point along roadway that passes under the Route 28 where flooding has occurred during large rain events. The City would like to get an alarm installed before the tunnel warning when it has flooded, but it would need to be a state project as Rt. 28 is a MassDOT road.
12	Commuter Rail (Fitchburg and Lowell lines)	Low elevation areas where flooding occurs along two separate Commuter Rail lines, the Fitchburg line, and the Lowell line. Flooding has been reduced on the Lowell line by work related to the Green Line Extension (up to a 50-year storm). However, the Fitchburg line is the lowest area in that part of city and still floods on a regular basis.
13	Lake Street residential area	Flooding has been reported several times on Lake Street, including August 10, 2008, August 27, 2011, July 24 2014, and September 15, 2015. The City held two public meetings on October 3 and 15, 2019. The remnants of Tropical Storm Fred also caused major flooding and damage on August 19, 2021. This flooding may be increasing as weather patterns change. Flood insurance has been recommended for the property owners on Lake Street.

Repetitive Loss Structures

As defined by FEMA, a repetitive loss property is a NFIP-insured structure that has had two or more paid flood losses of $1,000 or more in any given 10-year period since 1978. There is one repetitive loss properties in Somerville, which is a multifamily residential property. For more information on repetitive losses see https://www.fema.gov/txt/rebuild/repetitive_loss_faqs.txt and https://www.fema.gov/repetitive-flood-claims-grant-program-fact-sheet.

CLIMATE CHANGE IMPACTS ON FLOODING

Precipitation-based Flooding

Somerville's *Climate Change Vulnerability Assessment* addresses the projected future impacts of climate change on both inland and coastal flooding. This assessment utilized projections for future increases in sea level rise, storm surge and precipitation to assess the potential impacts of climate change on Somerville's critical assets and systems over time. The study employed climate change projections that are consistent with analyses that have been conducted by the Cities of Cambridge and Boston. In the Boston metro region, sea level is projected to rise approximately 4-8" by 2030 and 15-36" by 2070. Table 9 displays the anticipated increases in precipitation in 2030 and 2070 for the 10-year, 24-hour and 100-year, 24-hour design storm.

Table 9: Precipitation Projections

Design Storm	Present-day	2030	2070
10-year, 24-hour	4.9 in	5.6 in	6.4 in
100-year, 24-hour	8.9 in	10.2 in	11.7 in

Source: Somerville Climate Change Vulnerability Assessment, 2017

The analysis summarizes key vulnerabilities of the City to precipitation-based flooding as follows:

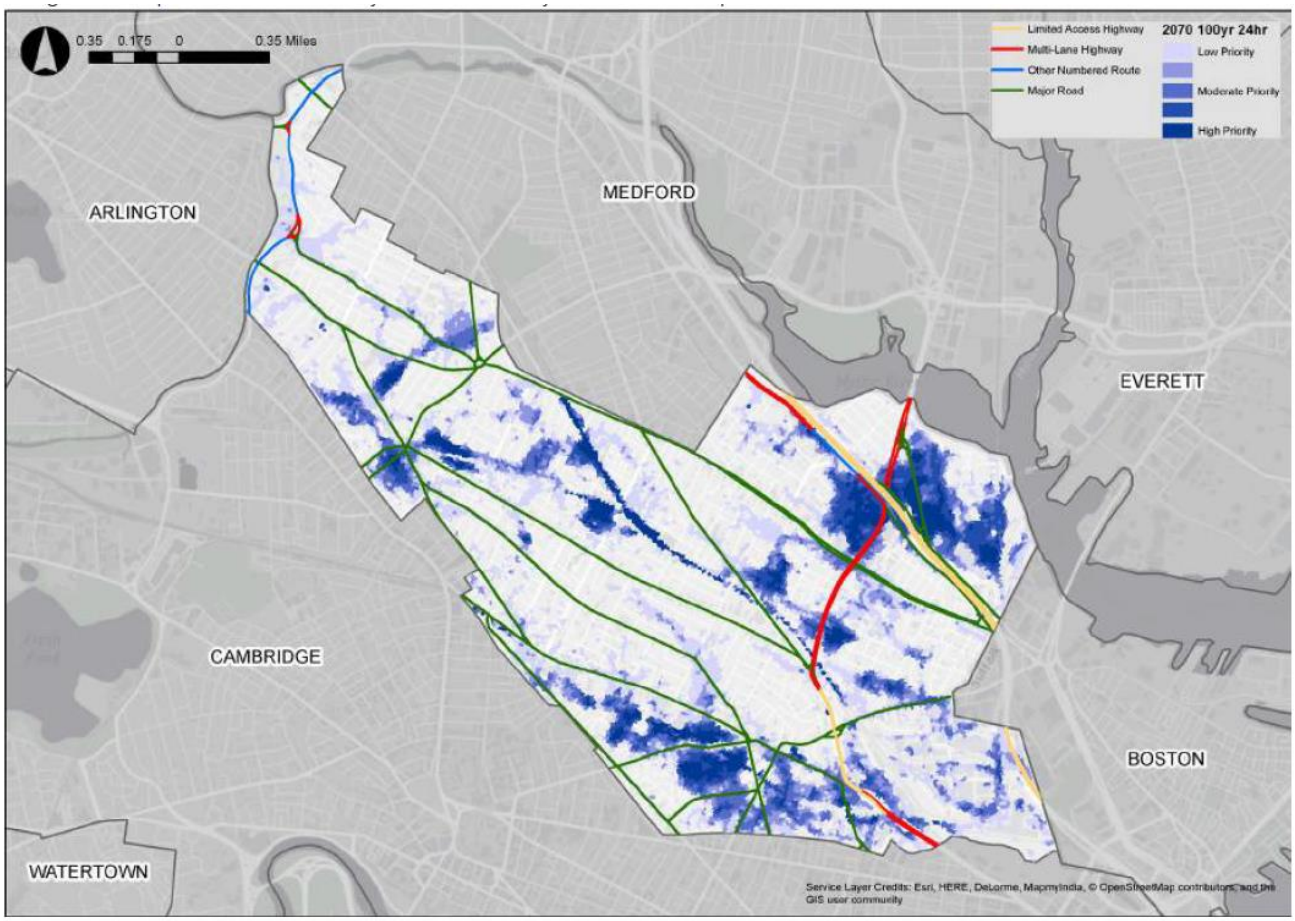
• The Somerville Fire Department Headquarters and the Emergency Operations Center at the Police Department Headquarters are currently exposed to precipitation-based flooding impacts and are expected to experience increasing impacts from the 10-year and 100-year storms. The City is designing a new Public Safety facility at a different site that is not subject to flooding.

• The District Court and District Attorney's Office play regional roles in the Boston metropolitan region and could experience significant impacts from both sea level rise and storm surge as well as precipitation-based flooding

• Routes I-93 and 28, Assembly Square Station, Davis Square Station and the proposed Green Line extension and associated stations could experience significant impacts from rainfall events.

The Climate Change Vulnerability Assessment includes several maps showing areas potentially inundated by flooding under several scenarios. Figure 10 shows areas subject to inland flooding by a 100-year, 24-hour precipitation event in 2070, highlighting major road corridors.

Figure 10: Areas Inundated by the 100-Year, 24 Hour Precipitation Event, 2070



Source: Somerville Climate Change Vulnerability Assessment, 2017

COASTAL FLOODING/SEA LEVEL RISE

Somerville currently has somewhat limited exposure to tidal flooding on the Mystic River due to the Amelia Earhart Dam, which limits tidal influence on the upper portion of the Mystic River. However, a section of the river below the dam borders on the eastern section of Somerville. Further, climate models of projected future sea level rise indicate that the City will be more vulnerable to coastal flooding in future decades.

The Somerville *Climate Change Vulnerability* Assessment utilized projections for future increases in sea level rise and storm surge to assess the potential impacts of climate change on Somerville's critical assets and systems. In the Boston metro region, sea level is projected to rise approximately 4-8" by 2030 and 15-36" by 2070.

The Climate Change Vulnerability Assessment lists several key areas of vulnerability to coastal flowing, as follows:

•The Amelia Earhart Dam could be regularly flanked by coastal storm events as early as 2035. This would result in significant coastal flood impacts to the Ten Hills and East Somerville & Assembly Square neighborhoods (see Figure 12).

• The District Court and District Attorney's Office play regional roles in the Boston metropolitan region and could experience significant impacts from both sea level rise and storm surge as well as precipitation-based flooding

• Major commuter corridors and key transportation infrastructure, including Routes I-93 and 28, Assembly Square Station, the Commuter Rail, the Orange Line, and the Commuter Rail Maintenance facility in addition to several bike paths and bus stops may be at risk from coastal flooding as early as 2030 and may be significantly impacted by 2070.

• The Mystic Generating Station in Everett, which is critical to the region's electricity supply, along with other energy (5 substations) and fuel facilities, is likely to experience impacts from coastal flooding by 2070.

• Somerville's combined sewer overflows (CSOs) are susceptible to increased inundation from coastal flood events. Inundation of CSO infrastructure can result in the discharge of raw sewage and present a serious public health risk from pollution of flood waters. There are 18 outfalls that are vulnerable to coastal flooding from sea level rise and storm surge, 4 of which are CSOs, and an additional 5-6 that could be prone to precipitation events, 2 of which are CSOs.

The analysis prioritizes concerns for two potential sources of coastal flooding, the Amelia Earhart Dam (Figure 11) and a flood pathway from the Schrafft Center in Charleston to Somerville. The flooding impacts related to the Amelia Earhart dam are summarized below:

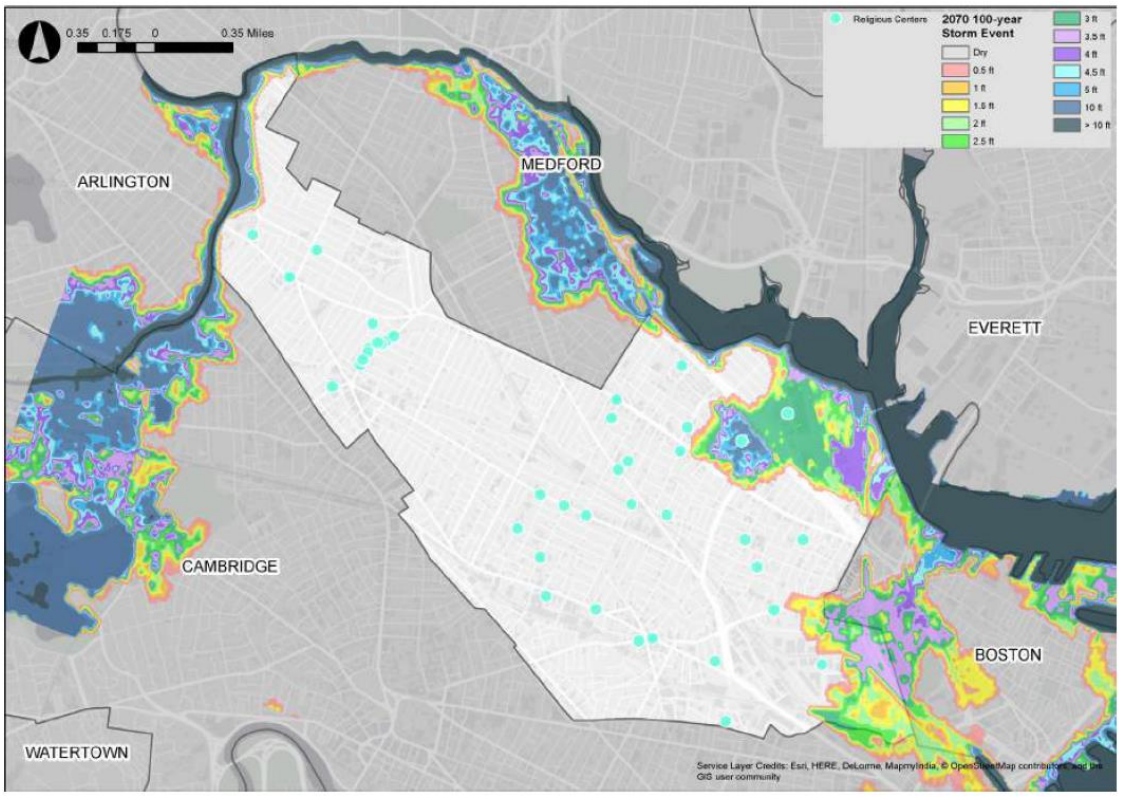
The Amelia Earhart Dam could be regularly flanked by coastal storm events as early as 2035. This would result in significant coastal flood impacts to the Ten Hills and East Somerville and Assembly Square neighborhoods. The dam is located on the Mystic River and plays a critical role in controlling flooding in Somerville and the larger regional area. Before the Dam was constructed, there is evidence of coastal flooding as far back as 1933; the flooding was significant, extending upstream into Malden and Medford. There is no evidence that the dam has been overtopped or breached since its construction. However, the modeling for this area suggests that the dam may be regularly flanked during 1% annual storm events (100-year storms) as early as 2035 and could be overtopped as early as 2055. This flanking is expected to exacerbate shorefront (riverine) flooding in the Ten Hills and East Somerville and Assembly Square neighborhoods, resulting in 1 to 2 feet of flooding in those areas. While most of this flooding would be limited to the shorefront, there is a smaller pathway in East Somerville that would extend inland several blocks.

Figure 11: Amelia Earhart Dam and Draw 7 Park

Source: Somerville Climate Forward Plan, 2018

The vulnerability assessment includes maps showing areas potentially inundated under several scenarios. Figure 12 shows areas subject to coastal flooding by a 100-year storm in 2070.

Figure 12: Areas Inundated by the 100-Year Coastal Storm Event, 2070



Source: Somerville Climate Change Vulnerability Assessment, 2017

The analysis also identifies a potential future flood pathway from the Schrafft Center, as follows:

> The Schrafft Center flood pathway in Boston, north of Sullivan Square, is of immediate concern to Somerville. It has the potential to flood under a present-day extreme event. While the entry point for this pathway is not under Somerville's jurisdiction, flooding in this area could have significant implications in the Ward Two & Inner Belt neighborhood. Under current conditions, there could be 0.5 to 1 foot of flooding along the western boundary of Ward Two & Inner Belt. By 2070, the extent and depth of that flooding would increase substantially and reach depths of up to 3 feet in some areas, as well as encroaching on the southeast section of the East Somerville & Assembly Square neighborhood. The City of Boston is currently developing design solutions to address this flood pathway; however, the City of Somerville should continue to advocate for flood protection solutions in this area to ensure that the solutions are ultimately implemented. In addition, there is an opportunity for future development in and around this area to be more resilient to flooding and be coupled with solutions to address flooding concerns.

DAM FAILURE

Dams can fail because of structural problems or age, independent of any storm event. Earthquakes can be a cause of dam failure by causing structural damage. Dams can also fail structurally because of flooding arising from a storm, or they can overspill due to flooding. In the event of a dam failure, the energy of the water stored behind even a small dam can cause loss of life and property damage if there are people or buildings downstream. The number of fatalities from a dam failure depends on the amount of warning provided to the population and the number of people in the path of the dam's floodwaters.

A concern for dams in Massachusetts is that many were built in the 19th century without the benefits of modern engineering or construction oversight. In addition, some dams have not been properly maintained. The increasing intensity of precipitation is the primary climate concern related to dams, as they were most likely designed based on historic weather patterns. The SHMCAP indicates that changing precipitation patterns may increase the likelihood of overflow events. Dam failure is a highly infrequent occurrence, but a severe incident could result in loss of lives and significant property damage. According to the Association of State Dam Safety Officials, three dams have failed in Massachusetts since 1984, one of which resulted in a death.

A review of information available from the Division of Conservation and Recreation (DCR) statewide dam database was used to identify dams in Somerville. DCR assesses dams using the three hazard classifications below:

> • High Hazard: Dams located where failure or mis-operation will likely cause loss of life and serious damage to home(s), industrial or commercial facilities, important public utilities, main highway(s) or railroad(s).

• Significant Hazard: Dams located where failure or mis-operation may cause loss of life and damage home(s), industrial or commercial facilities, secondary highway(s) or railroad(s) or cause interruption of use or service of relatively important facilities.

• Low Hazard: Dams located where failure or mis-operation may cause minimal property damage to others. Loss of life is not expected.

The City of Somerville does not own or operate any dams. There is one dam located in Somerville, the Amelia Earhart Dam, which is owned and operated by the Department of Conservation and Recreation (DCR). This dam is located on the east side of the City on the Mystic River between Somerville and the City of Everett. The dam is listed as a low hazard, but is estimated to need $5 million dollars in repairs, such as repairs to the current third pump and the possible installation of a fourth pump. The dam separates the tidal and the non-tidal parts of the Mystic River and is currently able to pump 4,000 cubic feet per second of flow from the Mystic and Malden Rivers against high tide into Boston Harbor. The pump improvements would increase the rate that flood water can travel out of the cities and towns along the Mystic River.

Another DCR dam, the Charles River Dam is not located in Somerville, but is located along the Charles River and associated basin, which is in close proximity to the southern and eastern most sections of Somerville (adjacent to the Cities of Cambridge and Boston). The Charles River Dam is classified as an urban flood control structure and has been identified as a Significant Hazard according to the DCR Hazard Potential Classification. Due to its location outside of and downstream from Somerville, this dam does not pose a hazard to the city.
The probability of future dam failure events is classified in the Massachusetts State Hazard Mitigation Plan as very low frequency, or an event that occurs less frequently than once in 100 years (less than 1% per year).

ICE JAMS

Ice jams occur in cold weather when normally flowing water begins to freeze effectively damming the waterway and causing localized flooding in the area. Flooding may also occur when ice jams break up and ice may pile up at culverts or around bridges. There is no known history of ice jams leading to flooding in Somerville and the local team did not identify this hazard as an issue for the city.

DROUGHT

Drought is a temporary irregularity in precipitation and differs from aridity since the latter is restricted to low rainfall regions and is a permanent feature of climate. Drought is a period characterized by long durations of below normal precipitation. Drought conditions occur in virtually all climatic zones, yet its characteristics vary significantly from one region to another since it is relative to the normal precipitation in that region. Drought can affect agriculture, water supply, aquatic ecology, wildlife, and plant life.

In Massachusetts, droughts are caused by the prevalence of dry northern continental air and a decrease in coastal- and tropical-cyclone activity. During the 1960's, a cool drought occurred because dry air from the north caused lower temperatures in the spring and summer of 1962-65. The northerly winds drove frontal systems to sea along the Southeast Coast and prevented the Northeastern States from receiving moisture (U.S. Geological Survey). This is considered the drought of record in Massachusetts.

Average annual precipitation in Massachusetts is 44 inches per year, with approximately 3 to 4 inches average amounts for each month of the year. Regional monthly precipitation ranges from zero to 17 inches. Statewide annual precipitation ranges from 30 to 61 inches. Thus, in the driest calendar year (1965), the statewide precipitation total of 30 inches was 68 percent of average.

Although Massachusetts is relatively small, it has a number of distinct regions that experience significantly different weather patterns and react differently to the amounts of precipitation they receive. The 2019 Massachusetts Drought Management Plan divides the state into seven regions: Western, Central, Connecticut River Valley, Northeast, Southeast, and Cape Cod, and Islands. Somerville is located in the Northeast region. Drought is a potential city-wide hazard in Somerville.

The MA Drought Management Plan was revised in 2019 to change the state's classification of droughts by establishing four levels to characterize drought severity: Mild Drought, Significant Drought, Critical Drought, and Emergency. These levels are based on conditions of natural resources and provide information on the current status of water resources. The levels provide a framework from which to take actions to assess, communicate, and respond to drought conditions. The Massachusetts drought levels are shown in comparison to the U.S. Drought Monitor levels in Table 10. The two sets of drought indices are similar, but Massachusetts combines the USDM's level D2 and D3 into one category, Critical Droughts.

Table 10: MA Statewide Drought Levels Compared to US Drought Monitor

USDM Names	Recurrence	Percentile Ranges	MA DMP Levels	MA Percentile Ranges	MA DMP Names
D0: Abnormally Dry	once per 3 to 5 years	21 to 30	1	>20 and ≤30%	Mild Drought
D1: Moderate	once per 5 to 10 years	11 to 20	2	>10 and ≤20%	Significant Drought
D2: Severe Drought	once per 10 to 20 years	6 to 10	3	>2 and ≤10%	Critical Drought
D3: Extreme Drought	once per 20 to 50 years	3 to 5			
D4: Exceptional Drought	once per 50 to 100 years	0 to 2	4	≤2%	Emergency

Source: Massachusetts Drought Management Plan, 2019

Water restrictions might be appropriate at the significant drought stage, depending on the capacity of each individual water supply system. A critical drought level indicates a severe situation and the possibility that a drought emergency may be necessary. A drought emergency is one in which mandatory water restrictions or use of emergency supplies is necessary. Drought levels are used to coordinate both state agency and local response to drought situations.

As dry conditions can have a range of different impacts, a number of drought indices are available to assess these various impacts. Massachusetts uses a multi-index system that takes advantage of several of these indices to determine the severity of a given drought or extended period of dry conditions. Drought level is determined monthly based on the number of indices which have reached a given drought level. Drought levels are declared on a regional basis for each of six regions in Massachusetts. County by county or watershed-specific determinations may also be made. A determination of drought level is based on seven indices:

1. Standardized Precipitation Index (SPI) reflects soil moisture and precipitation.
2. Crop Moisture Index: (CMI) reflects soil moisture conditions for agriculture.
3. Keetch Byram Drought Index (KBDI) is designed for fire potential assessment.
4. Precipitation Index is a comparison of measured precipitation amounts to historic normal precipitation.
5. The Groundwater Level Index is based on the number of consecutive month's groundwater levels are below normal (lowest 25% of period of record).
6. The Stream flow Index is based on the number of consecutive months that stream flow levels are below normal (lowest 25% of period of record).
7. The Reservoir Index is based on the water levels of small, medium, and large index reservoirs across the state, relative to normal conditions for each month.

Table 11 shows the range of values for each of the indices associated with the drought levels. Because drought tends to be a regional natural hazard, this plan references state data as the best available data for previous drought occurrences.

Table 11: Indices Values Corresponding to Drought Index Severity Levels

Index Severity Level	Standardized Precipitation Index	Streamflow	Lakes and Impoundments	Groundwater	Keetch-Byram Drought Index	Crop Moisture Index
0	>30th percentile				< 200	> -1.0
1	≤30 and >20				200-400	≤-1.0 and > -2.0
2	≤20 and >10				400-600	≤-2.0 and < -3.0
3	≤10 and >2				600-700	≤ -3.0 and > -4.0
4	≤2				700-800	≤-4.0

Source: Massachusetts Drought Management Plan, 2019

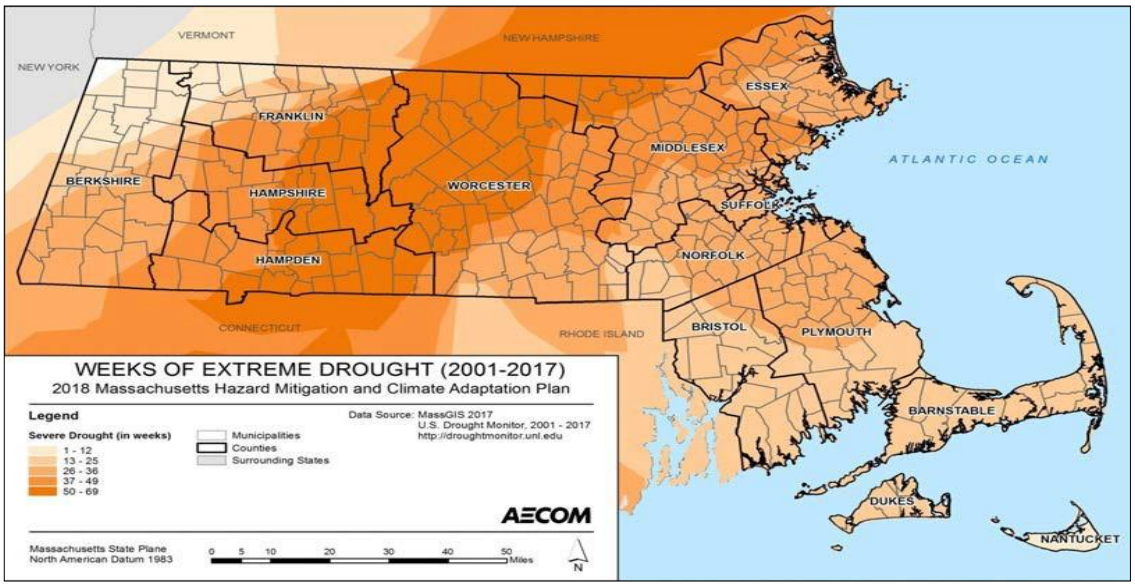
Determinations regarding the end of a drought or reduction of the drought level focus on two key drought indicators: precipitation and groundwater levels. These two factors have the greatest long-term impact on stream flow, water supply, reservoir levels, soil moisture and potential for forest fires.

Previous Occurrences of Drought

Drought emergencies have been reached infrequently, with five events occurring between 1850 and 2012: 1883, 1911, 1941, 1957, and 1965 to 1966. Due to its long duration, the drought from 1965 to 1966 is viewed as the most severe drought to have occurred in Massachusetts in modern times. The drought that extended from July 2016 to April 2017 reached the Drought Warning level.

The U.S. Drought Monitor characterizes droughts as moderate, severe, extreme, or exceptional. Severe drought is characterized by likely crop and pasture losses, water shortages, and water restrictions. As shown in Figure 13 below, Somerville experienced between 26 and 36 weeks of severe drought between 2001 and 2017.

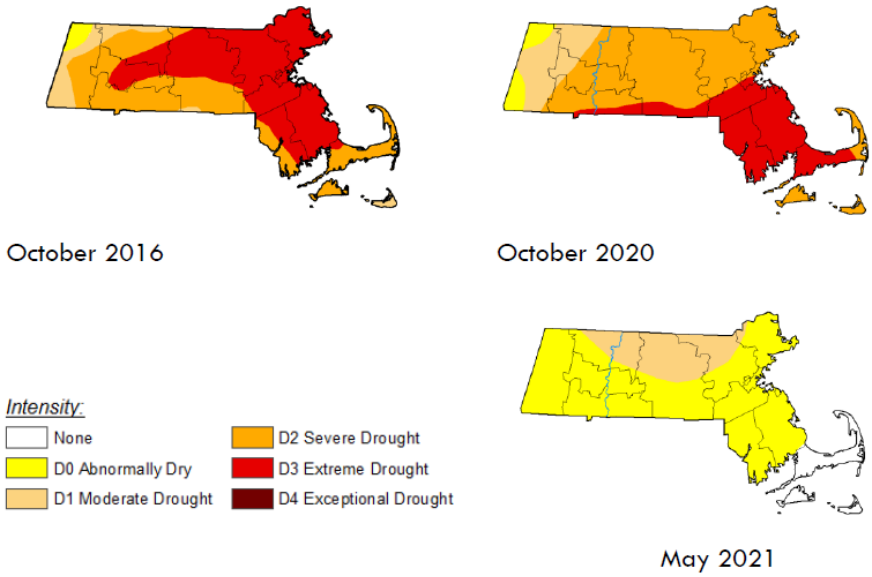
Figure 13: Weeks of Severe Drought (2001-2017)



Source: SHMCAP

In the last five years there have been three droughts in Massachusetts. The drought of 2016 was the worst one since 1985, with more than half of the state reaching the Extreme Drought stage for several months (Figure 14). This was followed by another drought just four years later in 2020, which was most severe in Southeastern Massachusetts and somewhat less so in Somerville. Finally, in the early spring of 2021 a third, milder, drought was declared. By the summer of 2021 conditions in the northeast region improved.

Figure 14: Recent Drought Events (2016-2021)



Source: U.S. Drought Monitor

Potential Drought Vulnerability

Somerville's potential vulnerability to a severe long-term drought could be a reduction in the availability of water supplies, which in turn could affect public health and economic activity. However, the City is a member of the Massachusetts Water Resources Authority (MWRA). Given the resilience of the MWRA system due to the exceptionally large amount of storage in the Quabbin and Wachusett Reservoirs, severe impacts of drought on the City of Somerville have never occurred and are unlikely.

Probability of Future Occurrences

Because drought tends to be a regional natural hazard, this plan references state data as the best available data for drought. Drought is a city-wide hazard in Somerville. The SHMCAP using data collected since 1850, calculates that statewide there is a 1% chance of being in a drought emergency in any given month. For drought warning and watch levels, the chance is 2% and 8% respectively in any given month (Table 12).

Table 12: Frequency of Massachusetts Drought Levels

Drought Level	Frequency Since 1850	Probability of Occurrence in a Given Month
Drought Emergency	5 occurrences	1% chance
Drought Warning	5 occurrences	2% chance
Drought Watch	46 occurrences	8% chance

Droughts and Climate Change

Droughts are projected to increase in frequency and intensity in the summer and fall as weather patterns change. Factors contributing to this include increasing evaporation as a result of warmer weather, earlier snow melt, and more extreme weather patterns. Drought impacts can include reduced groundwater and surface water levels, affecting water quality and quantity, and the organisms that rely on aquatic resources. Drought also increases stress on plant communities and, the likelihood of forest and brush fires. Communities may be affected by water use restrictions, affecting drinking water supply and outdoor water use. Economic sectors impacted could include recreation, agriculture, and forestry.

LANDSLIDES

According to the U.S. Geological Survey, "The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on an over steepened slope is the primary reason for a landslide, there are other contributing factors." Among the contributing factors are, erosion by rivers or ocean waves over steepened slopes; rock and soil slopes weakened through saturation by snowmelt or heavy rains; earthquake created stresses that make weak slopes fail; excess weight from accumulation of rain or snow; and stockpiling of rock or ore from waste piles or man-made structures. In Massachusetts, according to the SHMCAP, the most common cause of landslides are geologic conditions combined with steep slopes and/or heavy rains. Landslides associated with heavy rains typically occur on steep slopes with permeable soils underlain by till or bedrock.

Landslides can result from human activities that destabilize an area or can occur as a secondary impact from another natural hazard, such as flooding. In addition to structural damage to buildings and the blockage of transportation corridors, landslides can lead to sedimentation of water bodies. Typically, a landslide occurs when the condition of a slope changes from stable to unstable. Natural precipitation such as heavy snow accumulation, torrential rain, and run-off may saturate soil, creating instability enough to contribute to a landslide. Drought may also increase the likelihood of landslides if loss of vegetation decreases soil stability.

In Massachusetts, according to the SHMCAP, the most common cause of landslides are geologic conditions combined with steep slopes and/or heavy rains. Landslides associated with heavy rains typically occur on steep slopes with permeable soils underlain by till or bedrock.

There is no universally accepted measure of landslide extent, but it has been represented as a measure of the destructiveness. Table 13 summarizes the estimated intensity for a range of landslides. Fast moving rock falls have the highest intensity while slow moving landslides have the lowest intensity.

Table 13 Landslide Volume and Velocity

Estimated Volume (m^3)	Expected Landslide Velocity		
	Fast moving (rock fall)	**Rapid moving (debris flow)**	**Slow moving (slide)**
<0.001	Slight intensity	--	--
<0.5	Medium intensity	--	--
>0.5	High intensity	---	--
<500	High intensity	Slight intensity	--
500-10,000	High intensity	Medium intensity	Slight intensity
10,000 – 50,000	Very high intensity	High intensity	Medium intensity
>500,000	--	Very high intensity	High intensity
>500,000	--	--	Very high intensity

Source: *A Geomorphological Approach to the Estimation of Landslide Hazards and Risks in Umbria, Central Italy*, M. Cardinali et al, 2002

The SHMCAP, utilized data from the MA Department of Transportation from 1986 to 2006 to estimates that, on average, roughly one to three known landslides have occurred each year in the state. A slope stability map published by the MA Geological Survey and UMass-Amherst indicates that the most significant risk of landslide is in western Massachusetts. According to the SHMCAP, factors that influence landslide severity include soil properties, topographic position and slope, and historical incidence.

Somerville is classified as having low susceptibility and a low incidence of landslides (see Map 4, Appendix B). There have been no recorded landslides in Somerville. Should a landslide occur in the future, the type and degree of impacts would be highly localized. The city's vulnerabilities could include damage to structures, damage to transportation and other infrastructure, and localized road closures. Injuries and casualties, while possible, would be unlikely given the low extent and impact of landslides in Somerville.

Climate Change and Landslides

Changes in precipitation may increase the chance of landslides, as extreme rain events could result in more frequent saturated soils which are conducive to landslides. Drought may also increase the likelihood of landslides if loss of vegetation decreases soil stability.

RISING TEMPERATURES

AVERAGE AND EXTREME TEMPERATURES

Extreme temperatures occur when either high temperature or low temperatures relative to average local temperatures occur. These can occur for brief periods of time and be acute, or they can occur over extended periods of time where there is a long stretch of excessively hot or cold weather. Somerville has four well-defined seasons. The seasons have several defining factors, with

temperature one of the most significant. Extreme temperatures can be defined as those that are far outside of the normal seasonal ranges for Massachusetts.

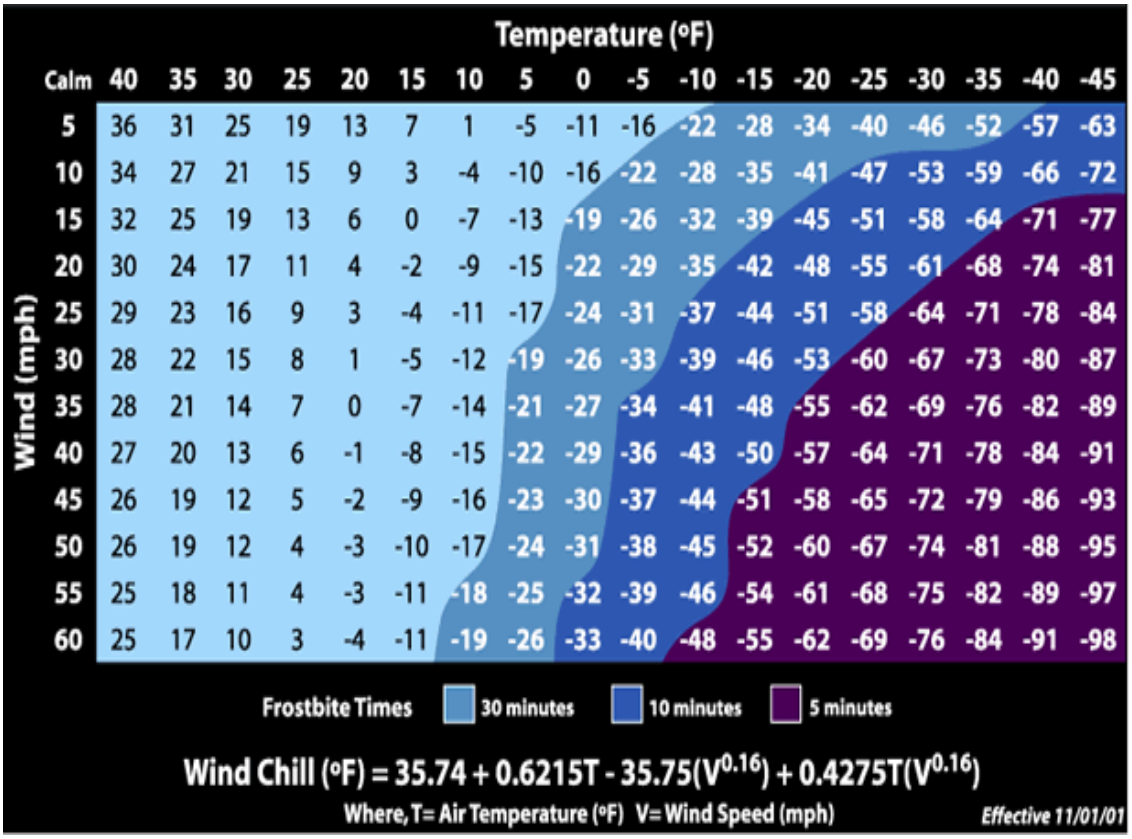
EXTREME COLD

The severity of extreme cold temperature is typically measured using the Wind Chill Temperature Index, which is provided by the National Weather Service (NWS). The wind chill is the apparent temperature felt on exposed skin due to the combination of air temperature and wind speed. The index is provided in Figure 15 below. A Wind Chill warning is issued when the Wind Chill Index is forecast to fall below -25 degrees F for at least 3 hours.

Extreme cold is a dangerous situation that can result in health emergencies for susceptible people, such as those without shelter, those who are stranded, or those who live in homes that are poorly insulated or without heat.

The best available local data on extreme cold events are recorded for Middlesex County through the National Centers For Environmental Information (NCEI). As shown in Table 14, there have been three reported extreme cold events in the past six years, which caused no deaths, no injuries, or property damage. This is an average of one event every 3.5 years. Extreme cold is a city-wide hazard for Somerville.

Figure 15 Wind Chill Temperature Index and Frostbite Risk



Source: National Weather Service

Table 14: Middlesex County Extreme Cold Occurrences 2010 through 2020

Date	Deaths	Injuries	Damages
2/14/2015	0	0	0
2/15/2016	0	0	0
2/16/2016	0	0	0

Source: NOAA, National Centers for Environmental Information

EXTREME HEAT

A heat wave in Massachusetts is defined as three or more consecutive days above 90°F. Another measure used for identifying extreme heat events relies on the Heat Index. According to the National Weather Service (NWS), the Heat Index is a measure of how hot it really feels relative humidity is factored in with the actual air temperature. The NWS issues an advisory when the heat index (Figure 16) is forecast to exceed 100°F for two or more hours; an excessive heat advisory is issued if the forecast predicts the temperature will rise above 105°F.

Figure 16: Heat Index Chart

		Temperature (°F)															
		80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
Relative Humidity (%)	40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
	45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
	50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
	55	81	84	86	89	93	97	101	106	112	117	124	130	137			
	60	82	84	88	91	95	100	105	110	116	123	129	137				
	65	82	85	89	93	98	103	108	114	121	128	136					
	70	83	86	90	95	100	105	112	119	126	134						
	75	84	88	92	97	103	109	116	124	132							
	80	84	89	94	100	106	113	121	129								
	85	85	90	96	102	110	117	126	135								
	90	86	91	98	105	113	122	131									
	95	86	93	100	108	117	127										
	100	87	95	103	112	121	132										

Category	Heat Index	Health Hazards
Extreme Danger	130 °F – Higher	Heat Stroke or Sunstroke is likely with continued exposure.
Danger	105 °F – 129 °F	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.
Extreme Caution	90 °F – 105 °F	Sunstroke, muscle cramps, and/or heat exhaustions possible with prolonged exposure and/or physical activity.
Caution	80 °F – 90 °F	Fatigue possible with prolonged exposure and/or physical activity.

b

Source: National Weather Service

The best available local data on extreme temperatures in the Boston area are available from NOAA's NOWData (NOAA Online Weather Data). Historic records of the number of days per year with high temperatures 90F or more for the last 100 years were compiled and are displayed graphically in Figure 17. The long-term trend is for more extreme heat in recent years.

Figure 17: Annual Number of Days > 90F in the Boston Area1920 - 2021

YEAR	#DAYS	YEAR	#DAYS	YEAR	#DAYS	YEAR	#DAYS
1920	5	1946	10	1972	9	1998	8
1921	13	1947	10	1973	19	1999	16
1922	9	1948	12	1974	7	2000	4
1923	12	1949	22	1975	15	2001	16
1924	14	1950	8	1976	17	2002	27
1925	13	1951	6	1977	18	2003	6
1926	6	1952	17	1978	9	2004	4
1927	6	1953	15	1979	12	2005	14
1928	16	1954	10	1980	22	2006	11
1929	15	1955	28	1981	11	2007	18
1930	19	1956	11	1982	7	2008	8
1931	17	1957	11	1983	30	2009	6
1932	7	1958	5	1984	18	2010	25
1933	16	1959	22	1985	4	2011	13
1934	5	1960	8	1986	4	2012	12
1935	4	1961	14	1987	9	2013	18
1936	10	1964	5	1988	25	2014	8
1937	16	1963	16	1989	7	2015	14
1938	10	1964	9	1990	10	2016	22
1939	10	1965	9	1991	27	2017	12
1940	7	1966	10	1992	2	2018	23
1941	18	1967	3	1993	20	2019	15
1942	6	1968	10	1994	22	2020	14
1943	17	1967	11	1995	17	2021	24
1944	21	1970	14	1996	3		
1945	8	1971	15	1997	19		

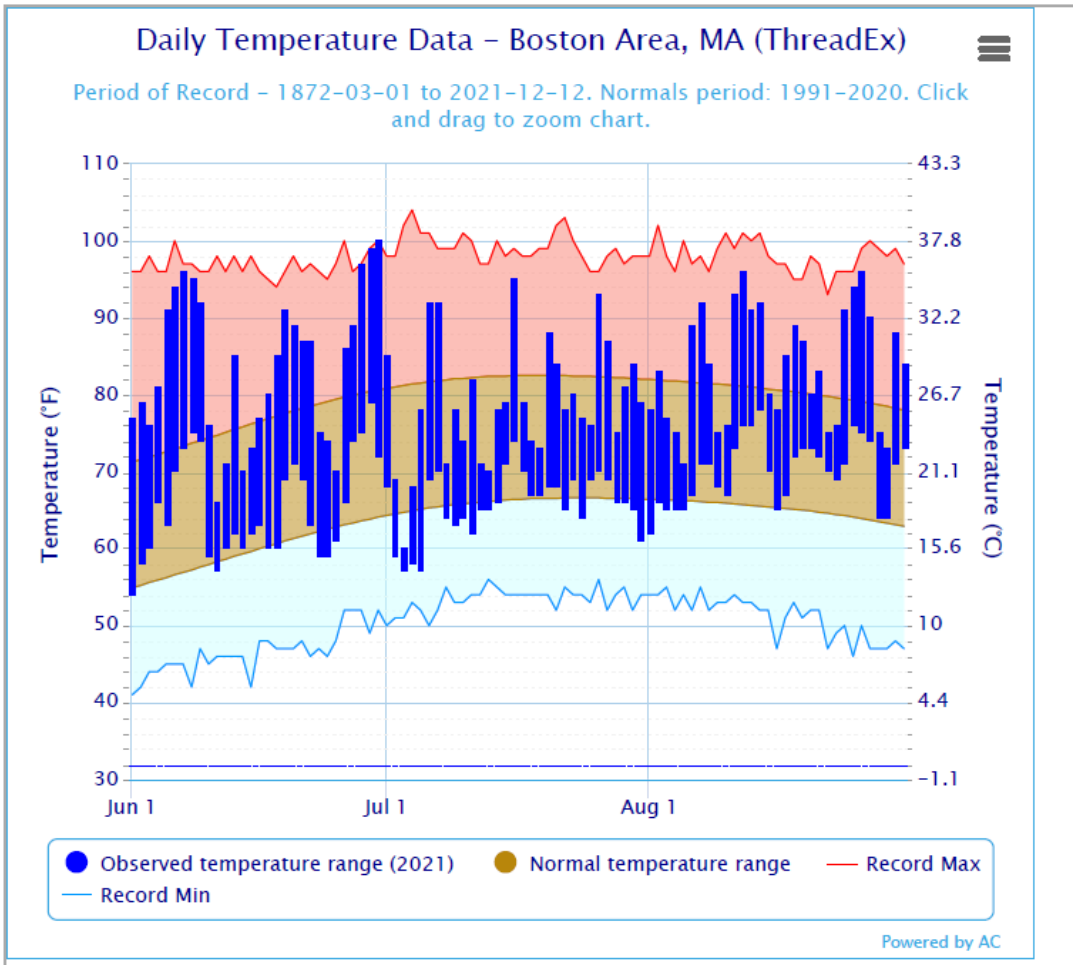
Source: NOAA Online Weather Data (NOWData), compiled by MAPC

0-10 DAYS	11-15 DAYS	16 – 20 DAYS	20 -30 DAYS

Heat Waves

While the number of 90F+ days per year is a broad indication of extreme temperatures, an indicator that relates more directly to public health impacts is the occurrence of multiple-day heat waves, defined at three or more consecutive days with high temperatures 90F or higher. The most recent summer of 2021 was an example of this, as shown in Figure 18.

Figure 18: Summer 2021 Temperatures, Boston Area



Source: NOAA

The summer of 2021 was particularly hot, with four heat waves, two in June and two in August. Two of these lasted for five days, one lasted four days, and one lasted three days. Overall, there were 24 days 90F or more, 17 of which occurred during the four heat waves. Reviewing similar records for the last decade, the number and duration of heat waves from 2010 to 2021 is summarized in Table 15.

Heat waves and lower air quality can threaten the health of vulnerable populations, including the very young, the elderly, and people with certain medical conditions. In Somerville, 10% of the residents are under the age of 15 and 9.5% are 65 years of age or older. Prolonged exposure

to high temperatures can cause heat-related illnesses, such as heat cramps, heat exhaustion, heat stroke, and death. Heat exhaustion is the most common heat-related illness and if untreated, it

Table 15: Heat Waves, 2010-2021, Boston Area

Year	Number of Heat Waves	Number of Days 90F+
2010	3	25
2011	2	13
2012	2	12
2013	3	18
2014	0	8
201d5	1	14
2016	1	22
2017	2	12
2018	2	25
2019	2	15
2020	3	14
2021	4	24

Source: NOAA

may progress to heat stroke. People who perform manual labor, particularly those who work outdoors, are at increased risk for heat-related illnesses. Prolonged heat exposure and the poor air quality and high humidity that often accompany heat waves can also exacerbate pre-existing conditions, including respiratory illnesses, cardiovascular disease, and mental illnesses.

The Wellbeing of Somerville report (2017) notes that extreme heat has disproportionate health impacts on both the young and the elderly:

> Young children are more vulnerable to extreme heat, poor air quality and insect-borne diseases. One reason for this is their limited ability to communicate when overheating or when left in dangerous situations; each year in the U.S., close to forty children die from heat exposure, typically in cars. In addition to greater physical frailty, children are less self-sufficient, more reliant on adults for transportation and other needs and less likely to cope emotionally during a disaster or climate event. These impacts on children often have a ripple effect on families and economics. If school is closed or daycares are unable to function due to weather, parents need to find alternative childcare options. This may impact the ability of parents to go to work and, therefore, impact the family's income, as well as the productivity of the businesses where parents are employed.
>
> Insect-borne diseases, such as Lyme disease and West Nile virus, are on the rise in Massachusetts. Research indicates that increases in temperature linked to climate change are projected to cause a correlating increase in the risk of insect-borne diseases. Lyme disease can reportedly also be transmitted to children in utero or through breastfeeding.

Impacts to children's health can include a wide range of ongoing physical, behavioral and cognitive problems.

Elderly residents often have greater physical limitations during a climate event. These limitations include higher overall health vulnerability, such as greater susceptibility to extreme heat and impacts from poor air quality and insect-borne diseases, among other illnesses. As a result of some of these vulnerabilities, older individuals – across all income brackets – have a greater reliance on support services, including senior centers and cooling centers during high heat events. Elderly residents that live alone may be more socially isolated and lack reliable access to transportation, which can make it more difficult for them to access support services or evacuate during emergency events. The City of Somerville currently provides transportation to seniors and disabled residents during storm events and high heat days; climate change is likely to increase demand for these types of services as such events become more frequent.

Exposure to poor air quality, which is impacted by heat, traffic pollution and rising pollen levels, can be linked to cardiac and lung problems, as well as cognitive and memory issues in seniors, altering quality of life, as well as longevity. Older adults, especially frail or immune compromised adults, may also be more at risk for the increasing presence of insect borne diseases such as West Nile virus.

Probability of Future Occurrences

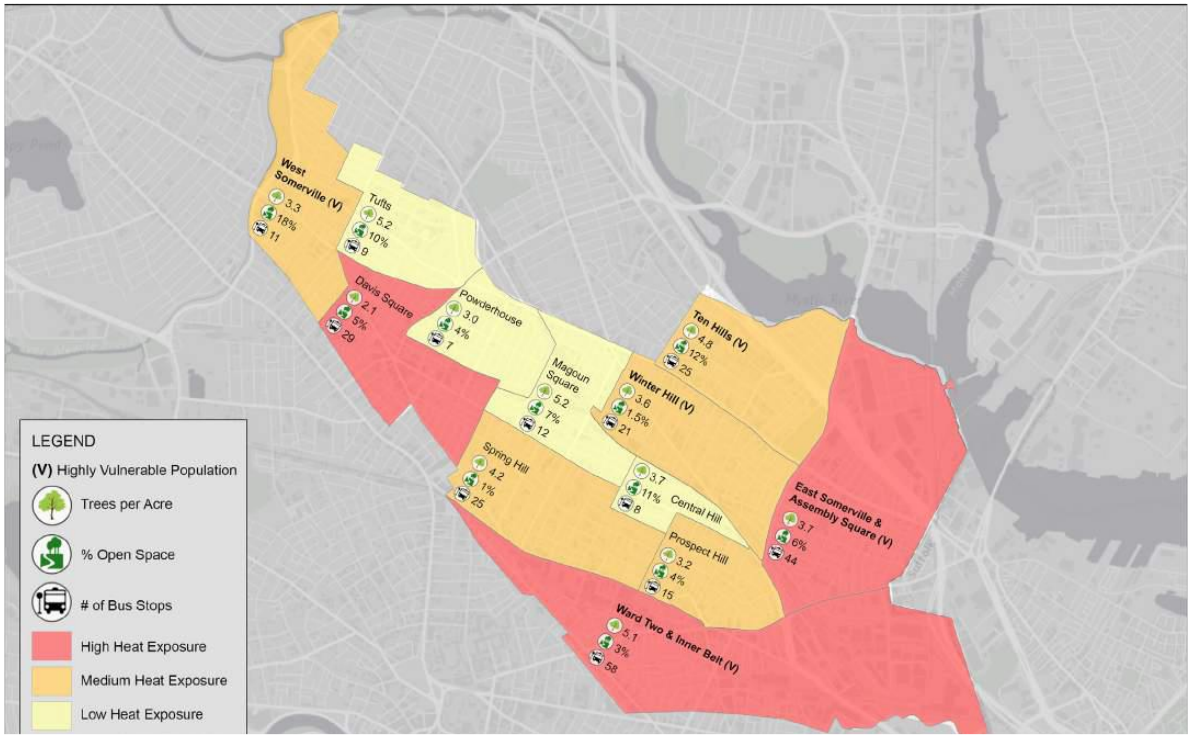
Based on the record of previous occurrences, extreme temperatures are a high frequency event as defined by the Massachusetts State Hazard Mitigation Plan. This hazard may occur more frequently than once in 5 years, or a greater than 20% chance per year.

Urban Heat Island

Due to what is termed the Urban Heat Island effect (UHI), areas with less shade and more dark surfaces (pavement and roofs) will experience even hotter temperatures; these surfaces absorb heat during the day and release it in the evening, keeping nighttime temperatures warmer as well. Map 10 in Appendix B displays areas that are among the hottest 5% of land in the MAPC region based on land surface temperature derived from satellite imagery on July 13, 2016, when the high temperature at Logan Airport was 92°F.

According to the Somerville Climate Change Vulnerability Assessment, some of the neighborhoods that exhibit greater presence of UHI factors are also home to higher concentrations of socially vulnerable populations. From a neighborhood perspective, Ward Two & Inner Belt and East Somerville & Assembly Square are two of the neighborhoods with the highest levels of social vulnerability in Somerville. This vulnerability is compounded by the fact that these neighborhoods also have the highest concentration of urban heat island (UHI) factors, which are likely to exacerbate the heat exposure in these areas. Figure 19 shows the outdoor heat exposure with additional statistics on attributes that could alleviate the UHI effect in each neighborhood.

Figure 19: Urban Heat Island with Attributes that May Alleviate Urban Heat Island Effect

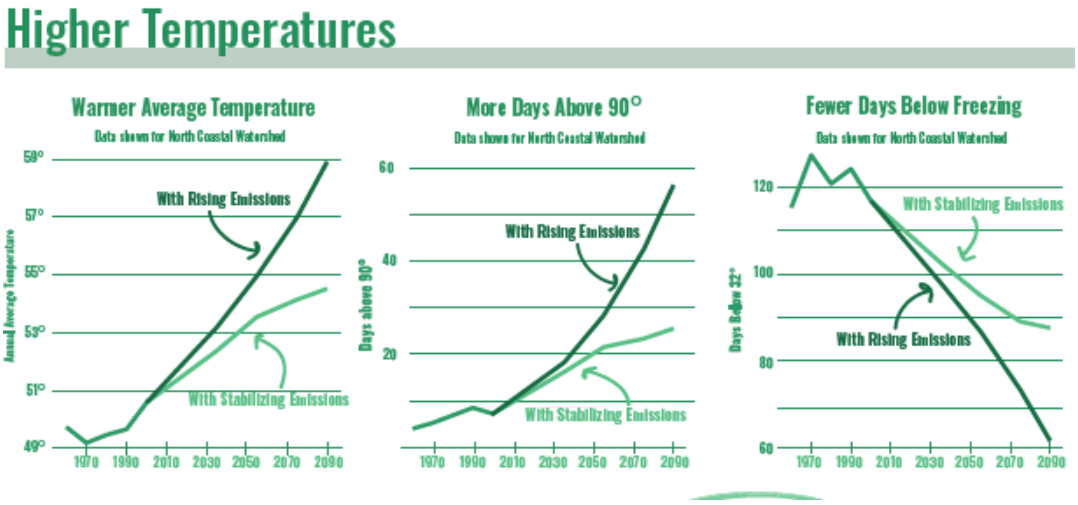


Source: Somerville Climate Change Vulnerability Assessment

CLIMATE CHANGE AND EXTREME TEMPERATURES

Extreme cold events are predicted to decrease in the future, while extreme heat days, as well as average temperatures are projected to increase (Figure 20). Average temperatures in Massachusetts are projected to increase by 3.8 to 10.8 degrees by the end of the century (SHMCAP). Over time our climate will become more similar to areas south of New England.

Figure 20: Massachusetts Projected Temperatures for Climate Scenarios to 2100



Source: ResilientMA.org

The Somerville Climate Change Vulnerability Assessment presents temperature projections for the City based on the Cambridge Climate Change Vulnerability Assessment (Table 16). Annual average temperatures are projected to increase by 2-3°F by 2030 and could increase by as much as 7-8°F (under the high emissions scenario) by 2070. By the end of the century, average summer temperatures are expected to experience proportionally greater temperature increases than winter temperatures. Winters will likely still be cold in Somerville, but summers could be much hotter than today.

Table 16: Somerville Projected Temperatures for Climate Scenarios to 2070

	1971-2000 Average	2030		2070	
		RCP4.5	RCP8.5	RCP4.5	RCP8.5
Average Annual Temperature	50.0	53.0	53.5	55.8	58.7
Average Summer Temperature	70.6	74.5	74.8	77.4	80.6
Average Winter Temperature	29.8	32.2	33.0	34.6	38.0

Source: Somerville Climate Change Vulnerability Assessment

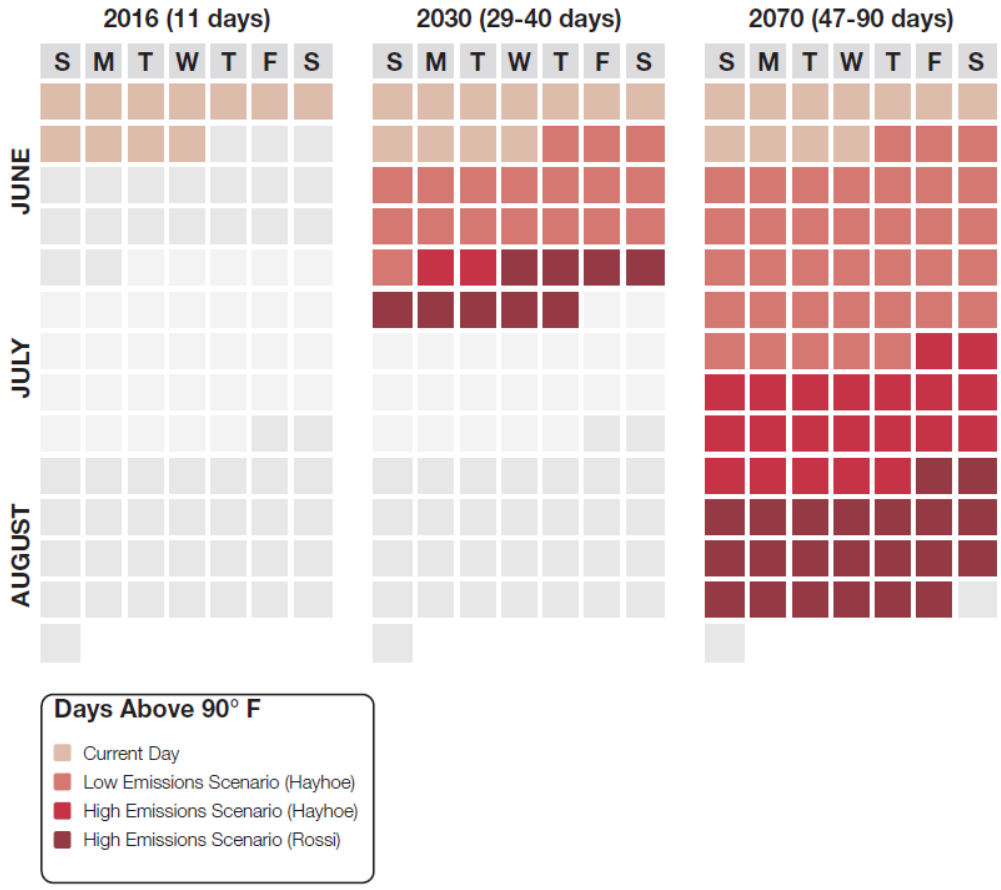
Extreme heat days are also projected to increase; by 2030, it is anticipated that the region could experience as many as 29-40 days over 90°F and, by 2070, that number could increase to 47-90 days over 90°F. By 2070, it is possible that the entire summer will be marked by temperatures above 90°F. (Figure 21).

The projected increase in extreme heat and heat waves is the source of one of the key health concerns related to climate change. Prolonged exposure to high temperatures can cause heat-related illnesses, such as heat cramps, heat exhaustion, heat stroke, and death. Heat exhaustion is the most common heat-related illness and if untreated, it may progress to heat stroke. Older adults are often at elevated risk due to a high prevalence of pre-existing and chronic conditions.

People who live in older housing stock and in housing without air conditioning have increased vulnerability to heat-related illnesses as are people who perform manual labor, particularly those who work outdoors. Power failures are more likely to occur during heat waves, affecting the ability of residents to remain cool during extreme heat. Individuals with pre-existing conditions and those who require electric medical equipment may be at increased risk during a power outage.

Prolonged heat exposure and the poor air quality and high humidity that often accompany heat waves can also exacerbate pre-existing conditions, including respiratory illnesses, cardiovascular disease, and mental illnesses. The Somerville CCVA concludes that:

Figure 21: Comparison of Days Above 90F for Low and High Emission Scenarios



Source: Somerville Climate Change Vulnerability Assessment

Without significant changes to the physical environment, this increase in heat exposure will have harmful public health implications for the residents of Somerville. Impacts, including mortality, heat stroke, and heat exhaustion will disproportionately affect the young, elderly, and those with pre-existing health conditions. Likewise, warming climates allow for the propagation of vector-borne diseases carried by insects that might otherwise not survive in colder environments. Examples include West Nile Virus, Eastern Equine Encephalitis (EEE), the Zika Virus, Lyme Disease and Dengue Fever. Air quality is another aspect that is often negatively impacted by extended periods of extreme heat. This results in increased respiratory and cardiac health concerns.

Impacts of extreme heat on natural resources include a longer growing season and northern migration of plants and animals, including invasive species. The SHMCAP identifies ecosystems that are expected to be particularly vulnerable to warming temperatures. These include coldwater fisheries, vernal pools, spruce-fir forests, northern hardwood forests (Maple, Beach, Birch), Hemlock forests, and urban forests (due to heat island impacts).

WILDFIRE HAZARDS

A wildfire is a non-structure fire occurring in a forested, shrub or grassland areas. In the Boston Metro region these fires rarely grow to the size of a wildfire, as seen more typically in the western U.S or even more rural areas of Massachusetts. A more likely occurrence is brush fires that typically burn no more than the underbrush of a forested area. There are three different classes of wildfires:

- Surface fires are the most common type and burn along the floor of a forest, moving slowly and killing or damaging trees.
- Ground fires are usually started by lightning and burn on or below the forest floor.
- Crown fires spread rapidly by wind, jumping along the tops of trees.

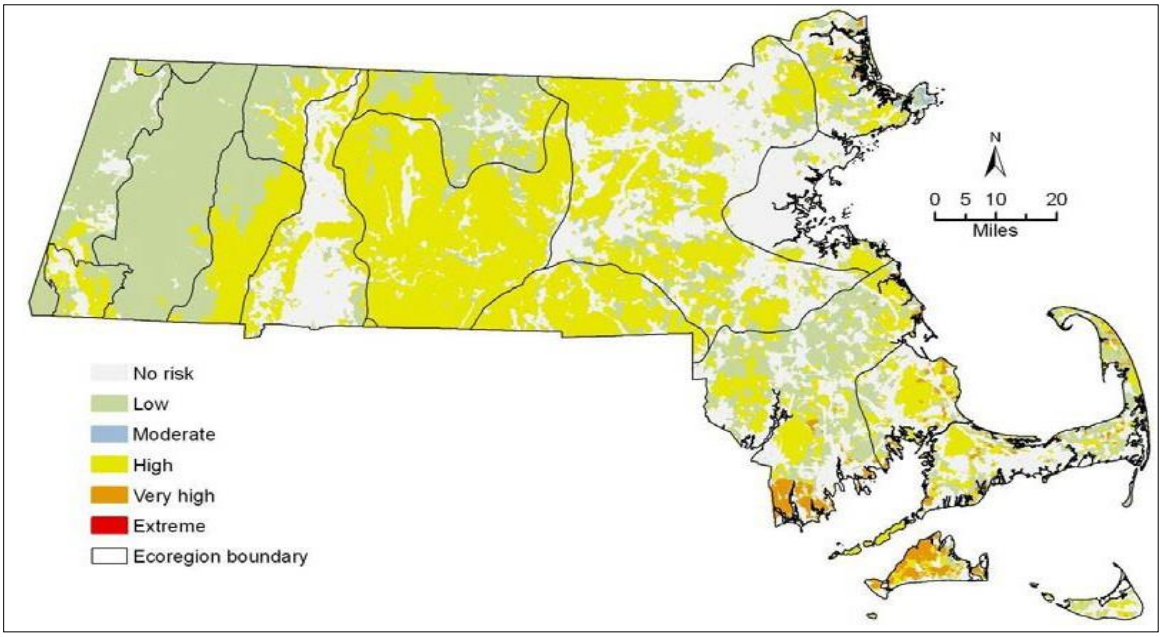
A wildfire differs greatly from other fires by its extensive size, the speed at which it can spread out from its original source, its potential to unexpectedly change direction, and its ability to jump gaps such as roads, rivers, and fire breaks. Wildfire season can begin in March and usually ends in late November. The majority of wildfires typically occur in April and May, when most vegetation is void of any appreciable moisture, making them highly flammable. Once "green-up" takes place in late May to early June, the fire danger usually is reduced somewhat. As the climate warms, drought and warmer temperatures may increase the risk of wildfire as vegetation dries out and becomes more flammable. The National Wildfire Coordinating Group classifies the severity of wildfires based on their acreage.

Fires can present a hazard where there is the potential to spread into developed or inhabited areas, particularly residential areas where sufficient fuel materials might exist to allow the fire the spread into homes. Protecting structures from fire poses special problems and can stretch firefighting resources to the limit. If heavy rains follow a fire, other natural disasters can occur, including landslides, mudflows, and floods. If the wildfire destroys the ground cover, then erosion becomes one of several potential problems. Should a wildfire occur in Somerville or in other nearby communities, the resulting smoke could have negative impacts on air quality. This could have public health impacts, particularly for those with respiratory conditions such as asthma.

Potential Wildfire Hazard Areas

The SCHMCAP includes a map that depicts statewide fire risk incorporating three risk components: fuel, wildland-urban interface, and topography (Figure 22). The wildland-urban interface reflects communities where housing and vegetation intermingle, and fire can spread from structures to vegetated areas. The most susceptible fuels are pitch pine, scrub oak and oak forests. Topography can affect the behavior of fires, as fire spreads more easily uphill. Somerville is shown in the no risk zone.

Figure 22: Wildfire Risk Areas in Massachusetts



Source: SHMCAP

In Somerville, when brushfires occur they are limited to small, vegetated pieces of land which may be located along transportation corridors and water bodies. An example of this is areas with stands of phragmites, which are grasses that grow in wetland areas. Since the previous plan, there were no brush fires in Somerville that resulted in significant property damage. The incidence of brush fires is distributed throughout the City with the railroad rights-of-way having a higher risk. Fire was not identified by the Hazard Mitigation Team as a common occurrence or a significant hazard in Somerville.

EXTREME WEATHER

HURRICANES AND TROPICAL STORMS

A hurricane is a violent wind and rainstorm with wind speeds of 74 to 200 miles per hour. A hurricane is strongest as it travels over the ocean and is particularly destructive to coastal property as the storm hits land. A tropical storm has similar characteristics, but wind speeds are between 34 and 73 miles per hour. Climate models suggest that hurricanes and tropical storms will become more intense as warmer ocean waters provide more fuel for the storms. In addition, rainfall amounts associated with hurricanes are predicted to increase because warmer air can hold more water vapor. Hurricanes are seasonal events that occur between June and November.

Hurricane intensity is measured according to the Saffir/Simpson scale, which categorizes hurricane intensity linearly based upon maximum sustained winds, barometric pressure, and storm surge

potential. These are combined to estimate potential damage. Table 17 gives an overview of the wind speeds, surges, and range of damage caused by different hurricane categories:

Table 17: Saffir/Simpson Scale

Scale No. (Category)	Winds (mph)	Surge (ft)	Potential Damage
1	74 – 95	4 - 5	Minimal
2	96 – 110	6 - 8	Moderate
3	111 – 130	9 - 12	Extensive
4	131 – 155	13 - 18	Extreme
5	> 155	>18	Catastrophic

Source: NOAA

Previous Occurrences

Since 1900, 39 tropical storms have impacted New England (NESEC), and Massachusetts has experienced approximately 32 tropical storms, nine Category 1 hurricanes, five Category 2 hurricanes and one Category 3 hurricane. Hurricanes in Massachusetts since 1938 are shown in Table 18.

As shown on Map 5 in Appendix B, no hurricanes have tracked through Somerville. A hurricane storm track is the line that delineates the path of the eye of a hurricane or tropical storm. However tropical storms and hurricanes have regional impacts, and Somerville can also experience the impacts of the wind and rain from hurricanes and tropical storms regardless of whether a storm track passes directly through the city. The hazard mapping indicates that the 100-year wind speed in Somerville is 110 miles per hour.

Table 18: Hurricane Records for Massachusetts 1938-2018

Hurricane Event	Date
Great New England Hurricane	September 21, 1938
Great Atlantic Hurricane	September 14-15, 1944
Hurricane Doug	September 11-12, 1950
Hurricane Carol	August 31, 1954
Hurricane Edna	September 11, 1954
Hurricane Diane	August 17-19, 1955
Hurricane Donna	September 12, 1960
Hurricane Gloria	September 27, 1985
Hurricane Bob	August 19, 1991
Hurricane Earl	September 4, 2010
Tropical Storm Irene	August 28, 2011
Hurricane Sandy	October 29-30, 2012

Source: National Oceanic and Atmospheric Administration

Falling trees and branches are a significant impact of the high winds of hurricanes, which often results in power outages or block traffic and emergency routes when they fall on roads. Rainfall associated with hurricanes can cause flooding In the city's rivers and streams, as well as localized urban drainage flooding. Potential hurricane damages to Somerville have been estimated using HAZUS-MH. Total damages are estimated at $52.4 million for a Category 2 hurricane and $246.6 million for a Category 4 hurricane. Hurricanes are a city-wide hazard in Somerville.

Based on records of previous occurrences, hurricanes in Somerville are a medium frequency event. This hazard occurs from once in 5 years to once in 50 years, or a 2% to 20% chance per year.

SEVERE WINTER STORM/NOR'EASTER

Nor'easters

A northeast storm, known as a nor'easter, is typically a large counterclockwise wind circulation around a low-pressure center. Featuring strong northeasterly winds blowing in from the ocean over coastal areas, nor'easters are relatively common in the winter months in New England occurring one to two times a year. The storm radius of a nor'easter can be as much as 1,000 miles and these storms feature sustained winds of 10 to 40 mph with gusts of up to 70 mph. These storms are accompanied by heavy rain or snow, depending on temperatures.

Previous Nor'easter Occurrences

Previous occurrences of nor'easters include the storm events shown on Table 19. Many of the historic flood events identified in the previous section were precipitated by nor'easters, including the "Perfect Storm" event in 1991. More recently, blizzards in February 2013, January 2015, and in March 2018 were large nor'easters that caused significant snowfall amounts.

Table 19: Nor'easter Events for Massachusetts, 1978 to 2020

Date	Nor'easter Event
February 1978	Blizzard of 1978
October 1991	Severe Coastal Storm ("Perfect Storm")
December 1992	Great Nor'easter of 1992
January 2005	Blizzard/Nor'easter
October 2005	Coastal Storm/Nor'easter
April 2007	Severe Storms, Inland & Coastal Flooding/Nor'easter
January 2011	Winter Storm/Nor'easter
October 2011	Severe Storm/Nor'easter
February 2013	Blizzard of 2013
January 2015	Blizzard of 2015
March 2015	March 2015 Nor'easters
January 2018	January 2018
March 2018	March 2018

Somerville is vulnerable to both the wind and precipitation that accompany nor'easters. High winds can cause damage to structures, fallen trees, and downed power lines leading to power outages. Intense rainfall can overwhelm drainage systems causing localized flooding of rivers and streams as well as urban stormwater ponding and localized flooding. Fallen tree limbs as well as heavy snow accumulation and intense rainfall can impede local transportation corridors, and block access for emergency vehicles. Nor'easters are also a cause of flooding. The entire City of Somerville is potentially at risk to the impacts of nor'easters.

Based on previous occurrences, nor'easters in Somerville are high frequency events. This hazard may occur more frequently than once in five years (greater than 20% chance per year).

Blizzards and Heavy Snow

Winter storms, including heavy snow, blizzards, and ice storms, are the most common and most familiar of the region's hazards that affect large geographic areas.

Winter storms are a combination hazard because they often involve wind, ice, and heavy snow fall. The National Weather Service defines "heavy snow fall" as an event generating at least four inches of snowfall within a 12-hour period. Blizzards and winter storms are often associated with a nor'easter event, a large counterclockwise wind circulation around a low-pressure center often resulting in heavy snow, high winds, and rain (see nor'easters above).
A blizzard is a winter snowstorm with sustained or frequent wind gusts to 35 mph or more, accompanied by falling or blowing snow which reduces visibility to or below ¼ mile. These conditions must be the predominant condition over a three-hour period. Extremely cold temperatures are often associated with blizzard conditions but are not a formal part of the definition. The hazard related to the combination of snow, wind, and low visibility significantly increases when temperatures drop below 20 degrees.

The Regional Snowfall Index (RSI) characterizes and ranks the severity of northeast snowstorms. RSI has five categories: Extreme, Crippling, Major, Significant, and Notable. RSI scores are a function of the area affected by the storm, the amount of snow, and the number of people living in the path of the storm. The largest RSI values result from storms producing heavy snowfall over large areas that include major metropolitan centers. The RSI categories are shown in Table 20.

Table 20: Regional Snowfall Index

Category	RSI	Value Description
1	1 – 3	Notable
2	3-6	Significant
3	6-10	Major
4	10-18	Crippling
5	18+	Extreme

Source: SHMCAP, 2018

The most significant winter storm in recent history was the "Blizzard of 1978," which resulted in over three feet of snowfall and multiple day closures of roadways, businesses, and schools. Table 21 shows the blizzards and severe winter storms that were declared disasters since 1966:

Table 21: Severe Winter Storm Disaster Declarations in Eastern MA

Storm Event	Date
Severe Winter Storm and Snowstorm	March 2018
Severe Winter Storm, Snowstorm, Flooding	January 2015
Severe Winter Storm, Snowstorm, Flooding	February 2013
Severe Storm and Snowstorm	October 2011
Severe Winter Storm and Snowstorm	January 2011
Severe Winter Storm and Flooding	December 2008
Blizzard	December 1992
Winter Coastal Storm	October 1991
Blizzard of 1978	February 1978
Coastal Storm, Flood, Ice, Snow	January 1966

Source: FEMA

The best available local data on past occurrences and impacts of winter storm events are reported for Middlesex County by the National Centers for Environmental Information (NCEI). From 2010 through 2020, Middlesex County experienced 19 heavy snowfall events, resulting in no injuries or deaths, and over a million dollars in property damage, as shown in Table 22. Heavy snow is considered to be high frequency events based on past occurrences, as there have been 19 events in the past eleven years, for an average of almost 2 events each winter.

Table 22: Heavy Snow Events in Middlesex County, 2010 through 2020

Date	Deaths	Injuries	Property Damage ($)
12/26/2010	0	0	0
1/12/2011	0	0	50000
1/18/2011	0	0	0
1/21/2011	0	0	0
2/1/2011	0	0	1109500
2/29/2012	0	0	0
3/1/2012	0	0	0
12/17/2016	0	0	0
1/7/2017	0	0	0
2/9/2017	0	0	0
2/12/2017	0	0	0
12/9/2017	0	0	0
1/4/2018	0	0	3000
2/17/2018	0	0	0
3/7/2018	0	0	25000
3/13/2018	0	0	0

3/13/2018	0	0	10000
1/19/2019	0	0	0
3/3/2019	0	0	0
Total	**0**	**0**	**1197500**

Source: NOAA, National Centers for Environmental Information

The majority of blizzards and ice storms in the region cause more inconvenience than they do serious property damage, injuries, or deaths. However, periodically, a storm will occur which is a true disaster, and necessitates intense large-scale emergency response. The impacts of winter storms are often related to the weight of snow and ice, which can cause roof collapses and also causes tree limbs to fall. This in turn can cause property damage and potential injuries. Power outages may also result from fallen trees and utility lines.

Winter storms are a potential city-wide hazard in Somerville. Map 6 in Appendix A indicates that the average annual average snowfall in most of Somerville is between 48 and 72 inches. A number of public safety issues can arise during snowstorms. Impassible streets are a challenge for emergency vehicles and affect residents and employers. Snow-covered sidewalks force people to walk in streets, which are already less safe due to snow, slush, puddles, and ice. Large piles of snow can also block sight lines for drivers, particularly at intersections. Refreezing of melting snow can cause dangerous roadway conditions. In addition, transit operations may be impacted, as they were in the 2015 blizzards which caused the closure of the MBTA system for one day and limited services on the commuter rail for several weeks.

Heavy snow and blizzards are considered to be high frequency events in Somerville based on past occurrences. This hazard occurs more than once in five years, with a greater than 20 percent chance of occurring each year.

Climate Change and Nor'easters/Winter Storms

As with hurricanes, warmer ocean water and air will provide more fuel for winter storms. According to the SHMCAP it appears that Atlantic coast nor'easters are increasing in frequency and intensity. Further, the SHMCAP notes that research suggests that warmer weather in the Artic is producing changes to atmospheric circulation patterns that favor the development of winter storms in the Eastern United States.

ICE STORMS

The ice storm category covers a range of different weather phenomena that collectively involve rain or snow being converted to ice in the lower atmosphere leading to potentially hazardous conditions on the ground. Ice storm conditions are defined by liquid rain falling and freezing on contact with cold objects, creating ice buildups of one-fourth of an inch or more. An ice storm warning, which is now included in the criteria for a winter storm warning, is issued when a half inch or more of accretion of freezing rain is expected.

Sleet and hail are other forms of frozen precipitation. Sleet occurs when raindrops fall into subfreezing air thick enough that the raindrops refreeze into ice before hitting the ground. The difference between sleet and hail is that sleet is a wintertime phenomenon whereas hail falls from convective clouds (usually thunderstorms), often during the warm spring and summer months (see a description of hail in the Other Severe Weather section below)

The best available local data on previous ice storm events are recorded for Middlesex County through the National Centers for Environmental Information (NCEI).. Middlesex County experienced three ice storm events from 2000 through 2021, as shown in Table 23. These events resulted in $3.165 in property damage, no injuries and no deaths. However, given the regional nature of ice storms, most of the damages occurred in the portions of Middlesex county farther inland and at a higher elevation than Somerville. The City's location in the milder coastal region makes it somewhat less vulnerable to ice storms.

Table 23: Middlesex County Ice Storm Events, 2000 through 2020

Date	Type	Deaths	Injuries	Property Damage
11/16/2002	Ice Storm	0	0	150.00K
01/15/2007	Ice Storm	0	1	15.00K
12/11/2008	Ice Storm	0	0	3.000M

Source: NOAA, National Centers for Environmental Information

The greatest hazard is created by freezing rain conditions, which is rain that freezes on contact with hard surfaces leading to a layer of ice on roads, walkways, trees, and other surfaces. The conditions created by freezing rain can make driving particularly dangerous and emergency response more difficult. The weight of ice on tree branches can also lead to falling branches causing power outages and blocking roadways. The impacts of winter storms may also include roof collapses and property damage and injuries related to the weight of snow and ice.

Ice storms are considered medium frequency events based on past occurrences. This hazard occurs once in five to 50 years, with a 2% to 20% chance of occurring each year. There is some indication that as winters warm, temperatures may be more likely to produce icing conditions.

TORNADOES

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud. These events are spawned by thunderstorms and occasionally by hurricanes and may occur singularly or in multiples. They develop when cool air overrides a layer of warm air, causing the warm air to rise rapidly. Most vortices remain suspended in the atmosphere. Should they touch down, they become a force of destruction. Some ingredients for tornado formation include:

- Very strong winds in the mid and upper levels of the atmosphere

- Clockwise turning of the wind with height (from southeast at the surface to west aloft)
- Increasing wind speed with altitude in the lowest 10,000 feet of the atmosphere (i.e., 20 mph at the surface and 50 mph at 7,000 feet)
- Very warm, moist air near the ground with unusually cooler air aloft
- A forcing mechanism such as a cold front or leftover weather boundary from previous shower or thunderstorm activity

Tornado damage severity is measured by the Enhanced Fujita scale, which is based on the amount of damage created (Figure 23). As of February 1, 2007, the National Weather Service began rating tornados using the Enhanced Fujita-scale (EF-scale), which allows surveyors to create more precise assessments of tornado severity. The EF-scale is summarized in Figure 23.

Figure 23: Enhance Fujita Scale

Scale	Wind speed		Relative frequency	Potential damage	
	mph	km/h			
EF0	65–85	105–137	53.5%	Minor damage. Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over. Confirmed tornadoes with no reported damage (i.e., those that remain in open fields) are always rated EF0.	
EF1	86–110	138–178	31.6%	Moderate damage. Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.	
EF2	111–135	179–218	10.7%	Considerable damage. Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.	
EF3	136–165	219–266	3.4%	Severe damage. Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.	
EF4	166–200	267–322	0.7%	Extreme damage to near-total destruction. Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.	
EF5	>200	>322	<0.1%	Massive Damage. Strong frame houses leveled off foundations and swept away; steel-reinforced concrete structures critically damaged; high-rise buildings have severe structural deformation. Incredible phenomena will occur.	

Source: SHMCAP 2018

The frequency of tornadoes in eastern Massachusetts is low; on average, there are six tornadoes that touchdown somewhere in the Northeast region every year. The strongest tornado in Massachusetts history was the Worcester Tornado in 1953 (NESEC). Recent tornado events in

Massachusetts were in Springfield in 2011, in Revere in 2014, and in Concord in 2016. The Springfield tornado caused significant damage and resulted in four deaths in June of 2011. The Revere tornado touched down in Chelsea just south of Route 16, moved north into Revere's business district along Broadway, and ended near the intersection of Routes 1 and 60. The path was approximately two miles long and 3/8 mile wide, with wind speeds up to 120 miles per hour. Approximately 65 homes had substantial damages and 13 homes and businesses were rendered uninhabitable.

On August 22, 2016, an F1 tornado passed through part of the Town of Concord. It impacted an area 0.85 miles long by 400 yards wide. According to the report from the National Centers for Environmental Information:

> "This tornado touched down near the Cambridge Turnpike (Route 2) and headed northeast. Most of the damage was concentrated in an area beginning near the intersection of Lexington Road and Alcott Road and continuing up to the neighborhood of Alcott and Independence Roads. Numerous trees were uprooted or had the tops sheared off. These subsequently blocked roads, damaged homes, and downed power lines, cutting off power to the neighborhood. In addition, utility poles were downed either from the wind or from the downed power lines. Thirty-nine houses in this area were damaged. Only one house suffered significant structural damage. The historical home of Louisa May Alcott and her family was right next to the tornado path but was not damaged.

Since 1950, there have been 20 tornadoes in Middlesex County recorded by the National Centers for Environmental Information. None of the tornados impacted Somerville. There have been two F3 and four F2, nine F1, and two EF0 tornados. The 20 tornadoes resulted in a total of one fatality and 6 injuries. Damage estimates from all 20 tornadoes totaled $4.89 million, as summarized in Table 24.

Table 24 Tornado Records for Middlesex County

Date	Fujita	Fatalities	Injuries	Damage
10/24/1955	1	0	0	2.50K
6/19/1957	1	0	0	25.00K
6/19/1957	1	0	0	0.25K
7/11/1958	2	0	0	250.00K
8/25/1958	2	0	0	2.50K
7/3/1961	0	0	0	25.00K
7/18/1963	1	0	0	25.00K
8/28/1965	2	0	0	250.00K
7/11/1970	1	0	2	25.00K
10/3/1970	3	1	0	250.00K
7/1/1971	0	0	0	25.00K
11/7/1971	1	0	0	0.25K

Date	Fujita	Fatalities	Injuries	Damage
7/21/1972	2	0	4	2.500M
9/29/1974	3	0	1	250.00K
7/18/1983	0	0	0	0.25K
9/27/1985	1	0	0	0.25K
8/7/1986	1	0	0	250.00K
8/22/2016	1	0	0	1.000M
8/23/2021	0	0	0	8.00K
8/23/2021	0	0	0	2.00K
TOTAL		**1**	**6**	**4.89M**

Source: NOAA, National Centers for Environmental Information

Buildings constructed prior to current building codes may be more vulnerable to damages caused by tornadoes. Evacuation of impacted areas may be required on short notice. Sheltering and mass feeding efforts may be required along with debris clearance, search and rescue, and emergency fire and medical services. Key routes may be blocked by downed trees and other debris, and widespread power outages are also typically associated with tornadoes.

Although tornadoes are a potential city-wide hazard in Somerville, tornado impacts are relatively localized compared to severe storms and hurricanes. Damages from any tornado in Somerville would greatly depend on the track of the tornado. Based on the record of previous occurrences since 1950, Tornado events in Somerville are a low frequency event as there has been no tornado activity in Somerville.

According to the SHMCAP, it is possible that severe thunderstorms which can include tornadoes may increase in frequency and intensity due to climate change. However, scientists have less confidence in the models that seek to project future changes in tornado activity.

OTHER SEVERE WEATHER

SEVERE THUNDERSTORMS

While less severe than the other types of storms discussed, thunderstorms can lead to localized damage and represent a hazard risk for communities. A thunderstorm typically features lightning, strong winds, rain, and/or hail. Thunderstorms sometime give rise to tornados. On average, these storms are only around 15 miles in diameter and last for about 30 minutes. A severe thunderstorm can include winds of close to 60 mph and rain sufficient to produce flooding. The severity of thunderstorms ranges from commonplace and of short duration to intense storms that cause damage due to high winds, flooding, or lightning strikes.
The best available data on previous occurrences of thunderstorms in Somerville is for are recorded for Middlesex County through the National Centers for Environmental Information (NCEI). For the years 2015 through 2020, NCDC records show 41 thunderstorm events in

Middlesex County (Table 25). These storms resulted in a total of $1.6 million in property damage. There were no injuries or deaths reported. This is an average of 7 events per year.

Table 25: Middlesex County Thunderstorm Events, 2015 through 2020

Date	Max. Wind Speed (mph)	Deaths	Injuries	Property Damage
5/28/2015	45	0	0	7000
8/4/2015	40	0	0	110000
8/15/2015	45	0	0	85000
2/25/2016	50	0	0	201000
3/17/2016	45	0	0	10000
7/22/2016	50	0	0	60000
7/23/2016	50	0	0	295000
8/22/2016	50	0	0	51000
9/11/2016	50	0	0	120000
5/18/2017	50	0	0	3000
6/13/2017	52	0	0	37000
6/23/2017	50	0	0	29500
6/27/2017	50	0	0	2000
7/12/2017	50	0	0	19000
8/2/2017	50	0	0	14000
9/6/2017	50	0	0	8000
5/15/2018	40	0	0	12000
6/18/2018	50	0	0	59500
6/25/2018	43	0	0	12000
7/17/2018	45	0	0	3000
7/26/2018	50	0	0	5000
8/7/2018	50	0	0	3000
8/17/2018	50	0	0	4000
9/6/2018	50	0	0	2000
10/23/2018	46	0	0	10000
6/30/2019	50	0	0	800
7/17/2019	50	0	0	7250
7/31/2019	50	0	0	2500
8/7/2019	50	0	0	800
9/4/2019	50	0	0	21700
5/15/2020	60	0	0	285000
6/6/2020	50	0	0	7600
6/21/2020	50	0	0	38200
6/28/2020	50	0	0	6000
7/2/2020	50	0	0	15300
7/5/2020	50	0	0	12800

Date	Max. Wind Speed (mph)	Deaths	Injuries	Property Damage
7/23/2020	50	0	0	40600
7/30/2020	50	0	0	4400
8/22/2020	50	0	0	6000
8/23/2020	50	0	0	25600
8/27/2020	50	0	0	1600
TOTAL		**0**	**0**	**$1,638,150**

Source: NOAA, National Centers for Environmental Information

Severe thunderstorms are a city-wide hazard for Somerville. The city's vulnerability to severe thunderstorms is similar to that of nor'easters. High winds can cause falling trees and power outages, as well as obstruction of key routes and emergency access. Heavy precipitation may also cause localized flooding, both riverine and urban drainage related.

Based on the record of previous occurrences, thunderstorms in Somerville are high frequency events as this hazard has occurred an average of seven times per year in the past six years. As noted previously, the intensity of rainfall events has increased significantly, and those trends are expected to continue. The SHMCAP does not specifically address whether climate will affect the intensity or frequency of thunderstorms.

HAIL

Hail events are frequently associated with thunderstorms and other severe storm events. Hail size typically refers to the diameter of the hailstones. Warnings and reports may report hail size through comparisons with real-world objects that correspond to certain diameters as shown in Table 26:

Table 26: Hail Size Comparisons

Description	Diameter (inches)
Pea	0.25
Marble or mothball	0.50
Penny or dime	0.75
Nickel	0.88
Quarter	1.00
Half dollar	1.25
Walnut or ping pong ball	1.50
Golf ball	1.75
Hen's egg	2.00
Tennis ball	2.50
Baseball	2.75
Teacup	3.00
Grapefruit	4.00
Softball	4.50

Source: NOAA

The best available local data on previous hail events are recorded for Middlesex County through the National Centers for Environmental Information (NCEI). There were 27 hail events recorded from 2010 through 2020, as shown in Table 27. There was no property damages and no injuries or deaths reported for any of these hail events. Potential damages from larger-size hail could include damage to vehicles, windows, and other structures. These damages have not been reported in Somerville.

Table 27: Middlesex County Hail Events, 2010 through 2020

Date	Hail Size	Deaths	Injuries	Property Damage
db5/4/2010	0.75	0	0	0
5/7/2011	0.75	0	0	0
6/1/2011	0.75	0	0	0
8/2/2011	0.75	0	0	0
8/19/2011	0.75	0	0	0
3/13/2012	1.25	0	0	0
3/14/2012	0.88	0	0	0
6/23/2012	0.75	0	0	0
7/18/2012	1.75	0	0	0
10/30/2012	1	0	0	0
6/17/2013	0.75	0	0	0
5/25/2014	1	0	0	0
7/3/2014	1	0	0	0
8/7/2014	0.75	0	0	0
9/6/2014	0.88	0	0	0
8/4/2015	2	0	0	0
8/15/2015	0.88	0	0	0
7/23/2016	0.88	0	0	0
7/23/2016	0.75	0	0	0
6/27/2017	1	0	0	0
8/2/2017	0.75	0	0	0
6/22/2019	0.75	0	0	0
6/29/2019	0.75	0	0	0
6/6/2020	1	0	0	0
6/28/2020	1	0	0	0
7/30/2020	0.75	0	0	0
8/23/2020	1	0	0	0

Source: NOAA, National Centers for Environmental Information

*Magnitude refers to diameter of hail stones in inches

Hail events are a potential city-wide hazard in Somerville Based on the record of previous occurrences, hail events in Somerville are high frequency events as this hazard has occurred an average of two times per year in the past six years.

NON-CLIMATE INFLUENCED HAZARDS

EARTHQUAKES

Earthquakes are the sole natural hazard for which there is no established correlation with climate impacts. Damage in an earthquake stems from ground motion, surface faulting, and ground failure in which weak or unstable soils, such as those composed primarily of saturated sand or silts, liquefy. The effects of an earthquake are mitigated by distance and ground materials between the epicenter and a given location. An earthquake in New England affects a much wider area than a similar earthquake in California due to New England's solid bedrock geology (NESEC).

Seismologists use a magnitude scale known as the Richter scale to express the seismic energy released by each earthquake. The typical effects of earthquakes in various ranges are summarized in Table 28.

Table 28: Richter Scale and Effects

Richter Magnitudes	Earthquake Effects
Less than 3.5	Generally, not felt, but recorded
3.5- 5.4	Often felt, but rarely causes damage
Under 6.0	At most slight damage to well-designed buildings. Can cause major damage to poorly constructed buildings over small regions.
6.1-6.9	Can be destructive in areas up to about 100 km. across where people live.
7.0- 7.9	Major earthquake. Can cause serious damage over larger areas.
8 or greater	Great earthquake. Can cause serious damage in areas several hundred meters across.

Source: Nevada Seismological Library (NSL), 2005

From 1668 to 2016, 408 earthquakes were recorded in Massachusetts (NESEC). Most have originated from the La Malbaie fault in Quebec or from the Cape Anne fault located off the coast of Rockport. The region has experienced larger earthquakes in the distant past, including a magnitude 5.0 earthquake in 1727 and a 6.0 earthquake that struck in 1755 off the coast of Cape Anne. More recently, a pair of damaging earthquakes occurred near Ossipee, NH in 1940. A 4.0 earthquake centered in Hollis, Maine in October 2012 was felt in the Boston area. Historic records of some of the more significant earthquakes in the region are shown in Table 29.

Table 29: Historic Earthquakes in Massachusetts or Surrounding Area

Location	Date	Magnitude
MA - Cape Ann	11/10/1727	5
MA - Cape Ann	12/29/1727	NA
MA - Cape Ann	2/10/1728	NA
MA - Cape Ann	3/30/1729	NA
MA - Cape Ann	12/9/1729	NA
MA - Cape Ann	2/20/1730	NA
MA - Cape Ann	3/9/1730	NA
MA – Boston	6/24/1741	NA
MA - Cape Ann	6/14/1744	4.7
MA – Salem	7/1/1744	NA
MA - Off Cape Ann	11/18/1755	6
MA - Off Cape Cod	11/23/1755	NA
MA – Boston	3/12/1761	4.6
MA - Off Cape Cod	2/2/1766	NA
MA – Offshore	1/2/1785	5.4
MA - Wareham/Taunton	12/25/1800	NA
MA – Woburn	10/5/1817	4.3
MA - Marblehead	8/25/1846	4.3
MA – Brewster	8/8/1847	4.2
MA – Boxford	5/12/1880	NA
MA – Newbury	11/7/1907	NA
MA - Wareham	4/25/1924	NA
MA - Cape Ann	1/7/1925	4
MA - Nantucket	10/25/1965	NA
MA – Boston	12/27/74	2.3
MA - Nantucket	4/12/12	4.5
ME – Hollis	10/17/12	4.0

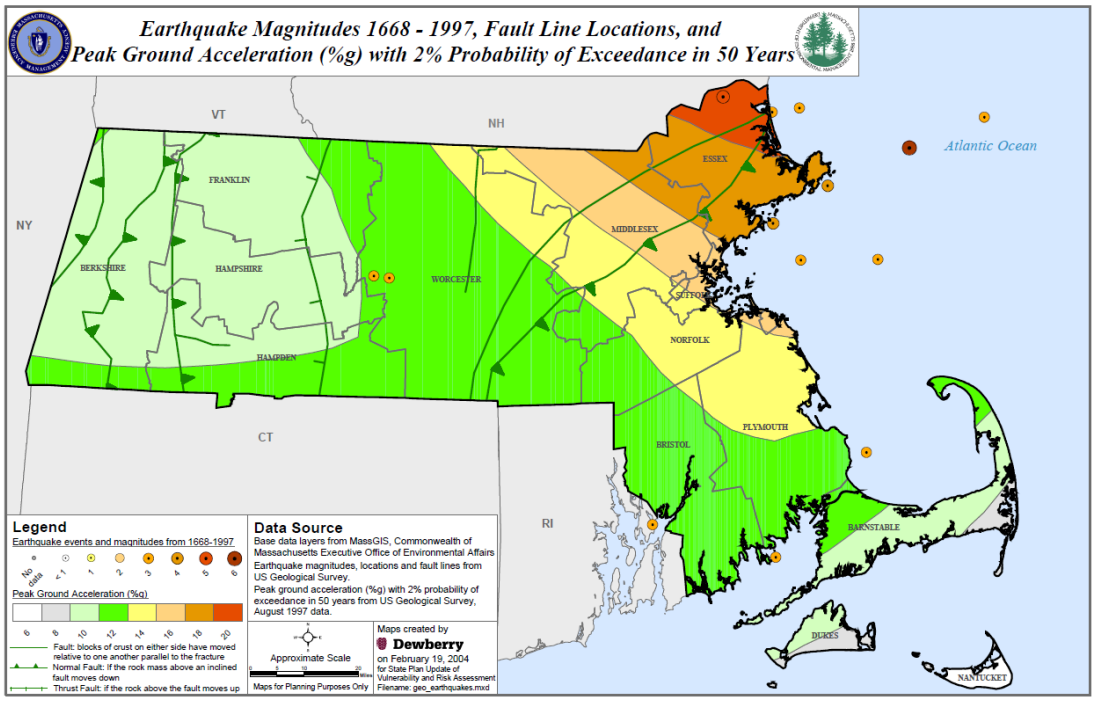
Source: Boston HIRA

One measure of earthquake risk is ground motion, which is measured as maximum peak horizontal acceleration, expressed as a percentage of gravity (%g). The range of peak ground acceleration in Massachusetts is from 10 %g to 20 %g, with a 2% probability of exceedance in 50 years, as shown in Figure 24. Somerville is in the 16 %g to 18 %g range, making it a moderate area of earthquake risk relative to the state, although the Massachusetts as a whole is considered to have a low risk of earthquakes compared to the rest of the country. There have been no recorded earthquake epicenters within Somerville.

Although New England has not experienced a damaging earthquake since 1755, seismologists state that a serious earthquake occurrence is possible. There are five seismological faults in Massachusetts, but there is no discernible pattern of previous earthquakes along these fault lines.

Earthquakes occur without warning and may be followed by aftershocks. The majority of older buildings and infrastructure were constructed without specific earthquake resistant design features.

Figure 24: Massachusetts Earthquake Probability Map



Source: MA Hazard Mitigation Plan 2013

Earthquakes are a hazard with multiple impacts beyond the obvious building collapse. Buildings may suffer structural damage which may or may not be readily apparent. Earthquakes can cause major damage to roadways, making emergency response difficult. Water lines and gas lines can break, causing flooding and fires. Another potential vulnerability is equipment within structures. For example, a hospital may be structurally engineered to withstand an earthquake, but if the equipment inside the building is not properly secured, the operations at the hospital could be severely impacted during an earthquake. Earthquakes can also trigger landslides.

According the SHMCAP there is a 10-15% chance of a magnitude 5 earthquake in a given ten-year period. Earthquakes are a potential city-wide hazard in Somerville. Although new construction under the most recent building codes generally will be built to seismic standards, much of the development in the city pre-dates the most recent building code. Potential earthquake damages to Somerville have been estimated using HAZUS-MH. Total building damages are estimated at $1.7 billion for a 5.0 magnitude earthquake and $10.4 billion for a 7.0 magnitude earthquake. Other potential impacts estimated by HAZUS are shown in Table 34.

LAND USE

Existing Land Use

The most recent land use statistics available from the state are from aerial imagery completed in 2016. Table 30 shows the acreage and percentage of land in 11 categories. If the primary residential categories are aggregated, residential uses make up 44.1% of the area of the city. The next largest category is Right-of-Way, which at 688 acres represents 26% of the total area. Commercial and industrial uses combined make up 19.6% of the city, and the tax-exempt category represents 13% of Somerville's land. More than half of this category is impervious cover. Land use is shown on Map 2 n Appendix A.

Table 30: City of Somerville Land Use

Land Use Type	Acres	Percentage
Residential - single family	186	7.0
Residential - multi-family	962	36.4
Mixed use, primarily residential	17	0.6
Commercial	253	9.6
Industrial	102	3.9
Water	5	0.2
Open land	67	2.5
Unknown	16	0.6
Right-of-way	688	26.0
Mixed Use-Other	1	0.00
Tax exempt	346	13.1
Total	**2,643**	**100**

Source: MassGIS 2016 Land Use Database

DEVELOPMENT TRENDS

Development trends throughout the metropolitan region are tracked by MAPC's Development Database, which provides an inventory of new development over the last decade. The database includes 33 developments in Somerville from 2017 to 2020, which are shown in Table 31 below

Several attributes of the developments are shown, including number of housing units and square footage of commercial space. Eight of the projects are housing developments, seven are commercial, and 18 are mixed use projects. The projects shown include a total of 1,629 housing units and 953,592, square feet of commercial space.

In order to characterize any change in the city's vulnerability associated with new developments, a GIS mapping analysis was conducted which overlaid the development sites with several

mapped hazards, including landslide risk, Hot Spots (the hottest 5% surface temperatures in the MAPC region), FEMA flood hazard areas, and areas subject to 10 feet of Sea Level Rise. As shown in Table 31, four of the 33 development sites are within the" Low Incidence" area for landslides, and the rest are in the "Moderate Susceptibility and Low Incidence" area. None of the developments are within a Hot Spot area, and only one is in a FEMA flood hazard area. Five sites are in an area that could be impacted in the future by 10 feet of Sea Level Rise.

NEW DEVELOPMENT

MAPC consulted with the Somerville Office of Strategic Planning and Community Development to determine areas that may be developed in the future, based on the City's comprehensive planning efforts and current trends and projects under review. The city identified 30 new and pending developments, shown in Table 32.

In order to characterize any change in the city's vulnerability associated with new developments, a GIS mapping analysis was conducted which overlaid the development sites with several mapped hazard areas, including landslide risk, Hot Spots (the hottest 5% surface temperatures in the MAPC region), FEMA flood hazard areas, and areas subject to 10 feet of Sea Level Rise. As shown in Table 32, six of the 30 development sites are within the" Low Incidence" area for landslides, and the rest are in the "Moderate Susceptibility and Low Incidence" area. Four of the developments are within a Hot Spot area, and two are partially within these areas. There are two developments in a FEMA 0.2% (500 year) flood hazard area, and four others with a very small part if the site in this hazard area (less than 10%), typically a part of the parcel that is not developed. Ten development sites are in an area that could be impacted in the future by 10 feet of Sea Level Rise, and seven others are partially located in this hazard area.

This information is provided so that planners can ensure that development proposals comply with floodplain zoning and that careful attention is paid to drainage, heat, and other issues. The City requires a Special Permit for most properties in the Floodplain District and applies stormwater regulations to new developments. This indicates that Somerville's new development should not significantly increase flooding if existing regulations are adhered to.

Table 31: Summary of MassBuilds Developments in Somerville, 2016-2020

Development	Housing Units	Comm Sq. Ft.	Landslide Risk	Hotspots	FEMA Flood Zones	Sea Level Rise: 10 feet
163 Glen Street	11	0	Moderate susceptibility and low incidence	No	No	No
181 Washington Street	30	2413	Moderate susceptibility and low incidence	No	No	No
483 Somerville Avenue	3	0	Moderate susceptibility and low incidence	No	No	No
Cobble Hill Center: Phase 1	160	13000	Moderate susceptibility and low incidence	No	No	No
Union Square Revitalization: D-4.5	18	1296	Moderate susceptibility and low incidence	No	No	No
315 Highland Ave	7	1600	Low incidence	No	No	No
Key Hotel (373 Beacon Street)	0	10500	Low incidence	No	No	No
111 South Street	207	0	Moderate susceptibility and low incidence	No	No	Yes
176-182 Broadway	19	3297	Moderate susceptibility and low incidence	No	No	No
Medical Marijuana Dispensary	0	4294	Moderate susceptibility and low incidence	No	No	No
39 Murdock St	3	0	Low incidence	No	No	No

Development	Housing Units	Comm Sq. Ft.	Landslide Risk	Hotspots	FEMA Flood Zones	Sea Level Rise: 10 feet
Assembly Row: Block 5	285	125560	Moderate susceptibility and low incidence	No	No	Yes
Broadway Residences	13	25000	Moderate susceptibility and low incidence	No	No	No
67 FLORENCE ST	6	0	Moderate susceptibility and low incidence	No	No	No
620 Broadway	11	1200	Low incidence	No	No	No
235 Lowell Street	6	0	Moderate susceptibility and low incidence	No	No	No
231 Lowell Street	19	1000	Moderate susceptibility and low incidence	No	No	No
90 Washington Street	154	13000	Moderate susceptibility and low incidence	No	No	No
444 Somerville Ave	0	45983	Moderate susceptibility and low incidence	No	No	No
Union Square Revitalization: 5.1 (P. O.)	0	45000	Moderate susceptibility and low incidence	No	No	No
500 Medford St	4	2593	Moderate susceptibility and low incidence	No	No	No
Davis 353	29	8300	Low incidence	No	Yes	No
140-150 Line Street	14	0	Moderate susceptibility and low incidence	No	No	No

Development	Housing Units	Comm Sq. Ft.	Landslide Risk	Hotspots	FEMA Flood Zones	Sea Level Rise: 10 feet
515 SOMERVILLE AVE	0	27000	Moderate susceptibility and low incidence	No	No	No
Union Square Revitalization: D-2	400	484460	Moderate susceptibility and low incidence	No	No	Yes
70 Prospect Street	14	1296	Moderate susceptibility and low incidence	No	No	Yes
229 Lowell Street	40	10000	Moderate susceptibility and low incidence	No	No	No
Union Square Revitalization: D-4.1	0	33000	Moderate susceptibility and low incidence	No	No	Yes
Union Square Revitalization: 7.1 & 7.2	50	0	Moderate susceptibility and low incidence	No	No	No
Union Square Revitalization: D-1.1	0	58000	Moderate susceptibility and low incidence	No	No	No
345 Medford Street	20	4000	Moderate susceptibility and low incidence	No	No	No
350-360 Medford Street	82	24000	Moderate susceptibility and low incidence	No	No	No
91 Marshall Street	24	7800	Moderate susceptibility and low incidence	No	No	No

Source: MassBuilds, MAPC

Table 32: Relationship of Development to Hazard Areas

Site ID	Development	Area (Acres)	Landslide Risk	Hotspots (op 5% land surface temperature in MAPC	FEMA Flood Zones	Sea Level Rise: 10 feet
A	North Point	9.90	Moderate susceptibility and low incidence			96.28% inundated by 10 ft. sea level rise
B	Boynton Yards	29.25	Moderate susceptibility and low incidence			99.83% inundated by 10 ft. sea level rise
C	455 Grand Union	1.65	Moderate susceptibility and low incidence			100.0% inundated by 10 ft. sea level rise
D	380 Somerville Ave	1.22	Moderate susceptibility and low incidence			
E	515 Somerville Ave	1.07	Moderate susceptibility and low incidence			
F	395 Alewife Brook Parkway	0.46	Low incidence	92.42% in top 5% hottest land surface	7.95% in X: 0.2% Annual Chance of Flooding	71.58% inundated by 10 ft. sea level rise
G	Waterworks 40B - Phase 2	1.35	Low incidence	32.52% in top 5% hottest land surface	8.27% in X: 0.2% Annual Chance of Flooding	65.59% inundated by 10 ft. sea level rise
H	7-9 Central Street	0.41	Moderate susceptibility and low incidence			
I	71 Bow Street	0.25	Moderate susceptibility and low incidence			
J	346 Somerville Ave	0.49	Moderate susceptibility and low incidence			77.03% inundated by 10 ft. sea level rise
K	Assembly Edge	1.47	Moderate susceptibility and low incidence		100.0% in X: 0.2% Annual Chance of Flooding	100.0% inundated by 10 ft. sea level rise
L	290 Revolution Drive/Alta XMBLY	3.82	Moderate susceptibility and low incidence		98.53% in X: 0.2% Annual Chance of Flooding	99.79% inundated by 10 ft. sea level rise
M	1-building MPSP	0.07	Moderate susceptibility and low incidence			
N	28 Fitchnut	1.50	Moderate susceptibility and low incidence			66.71% inundated by 10 ft. sea level rise
O	Self-Storage Building	1.65	Moderate susceptibility and low incidence			69.04% inundated by 10 ft. sea level rise

Site ID	Development	Area (Acres)	Landslide Risk	Hotspots (op 5% land surface temperature in MAPC	FEMA Flood Zones	Sea Level Rise: 10 feet
P	8 Medford St	0.12	Moderate susceptibility and low incidence			100.0% inundated by 10 ft. sea level rise
Q	26-28 South Street	0.21	Moderate susceptibility and low incidence			100.0% inundated by 10 ft. sea level rise
R	14 Ward St	0.24	Moderate susceptibility and low incidence			100.0% inundated by 10 ft. sea level rise
S	371 Highland Ave	0.19	Low incidence	100.0% in top 5% hottest land surface		
T	393 Highland Ave	0.44	Low incidence	100.0% in top 5% hottest land surface		
U	28-44 Broadway	0.44	Moderate susceptibility and low incidence			
V	96-100 Broadway	0.14	Moderate susceptibility and low incidence			
W	152-158 Broadway	0.12	Moderate susceptibility and low incidence			
X	Stop & Shop - 60 Cross Street	1.91	Moderate susceptibility and low incidence		0.31% in X: 0.2% Annual Chance of Flooding	68.14% inundated by 10 ft. sea level rise
Y	Clarendon Hill 40B; 3 apt buildings & townhouses	5.40	Low incidence	52.03% in top 5% hottest land surface	4.5% in X: 0.2% Annual Chance of Flooding	6.65% inundated by 10 ft. sea level rise
Z	20 Inner Belt Rd. & 56 Roland St.	2.71	Moderate susceptibility and low incidence			100.0% inundated by 10 ft. sea level rise
AA	13 Warwick	0.23	Low incidence			
AB	124 Highland Ave	0.17	Moderate susceptibility and low incidence			
AC	The Pit	0.30	Low incidence	100.0% in top 5% hottest land surface		
AD	3 Hawkins Street	0.32	Moderate susceptibility and low incidence			100.0% inundated by 10 ft. sea level rise

Source: Somerville Office of Strategic Planning and Community Development

CRITICAL FACILITIES & INFRASTRUCTURE IN HAZARD AREAS

Critical facilities and infrastructure include facilities that are important for disaster response and evacuation (such as emergency operations centers, fire stations, water pump stations, communications, and electricity) and facilities where additional assistance might be needed during an emergency (such as nursing homes, elderly housing, day care centers, etc.). There are 155 Critical Facilities identified in Somerville. They are listed in Table 33 and are shown on the maps in Appendix B.

Explanation of Columns in Table 33

- ***Column 1: ID #:*** The first column is an ID number which appears on the maps that are part of this plan. See Appendix B.
- ***Column 2: Name****:* The second column is the name of the site.
- ***Column 3: Type*:** The third column indicates what category of site it is.
- ***Column 4: Landslide Susceptibility*** from the Northeast States Emergency Consortium (NESEC)
- ***Column 5: FEMA Flood Zone*:** The fifth column addresses the risk of flooding. A "No" entry in this column means that the site is not within any of the mapped risk zones on the Flood Insurance Rate Maps (FIRM maps). If there is an entry in this column, it indicates the type of flood zone. as follows:
    - **Zone A** Areas subject to inundation by the 1-percent-annual-chance flood event. Because detailed hydraulic analyses have not been performed, no Base Flood Elevations (BFEs) or flood depths are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply.
    - **Zone AE** Areas subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods. Base Flood Elevations (BFEs) are shown. Mandatory flood insurance purchase requirements and floodplain management standards apply.
    - **Zone AH** Areas subject to inundation by 1-percent-annual-chance shallow flooding (usually areas of ponding) where average depths are 1–3 feet. BFEs derived from detailed hydraulic analyses are shown in this zone. Mandatory flood insurance purchase requirements and floodplain management standards apply.
    - **Zone X (shaded)** Moderate risk areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by a levee. No BFEs or base flood depths are shown within these zones. (formerly Zone B)
    - **Zone X (unshaded)** Minimal risk areas outside the 1-percent and .2 percent-annual-chance floodplains. No BFEs or base flood depths are shown within these zones. (formerly Zone C)
- Column 6: **Average Annual Snowfall** from the Northeast States Emergency Consortium (NESEC)
- Column 7: **Hot spots** indicates areas that are within the 5% of hottest areas in the MAPC region based on satellite data from 2016.
- Column 8: **Area Inundated by 10 feet of Sea Level Rise** from the Boston Harbor SLR model

Table33: Critical Facilities and Relationship to Hazard Areas

ID	Name	Type	Landslide Risk	FEMA Flood Zone	Average_ Annual Snowfall	Hot Spot	10ft Sea Level Rise
1	John Jeanne Jugan Pavilion	Elder Housing	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
3	Visiting Nurse Association	Elder Housing	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
4	Broadway Health Center	Medical Facility	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
5	Board of Health / Annex	Medical Facility	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
6	Hagan Manor	Elder Housing	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	Yes
7	Weston Manor	Elder Housing	Low incidence	No	H 48.1 - 72.0	No	No
8	Clarendon Hill Towers	Mixed Housing	Low incidence	No	H 48.1 - 72.0	No	No
9	Clarendon Hill Towers	Mixed Housing	Low incidence	No	H 48.1 - 72.0	No	No
10	Corbett	Elder Housing	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
11	Pearl Street Park	Elder Housing	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	No
12	Brady Towers	Elder Housing	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	No
13	Faulkner Towers	Elder Housing	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	Yes	No
14	Highland Gardens	Elder Housing	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No

ID	Name	Type	Landslide Risk	FEMA Flood Zone	Average_ Annual Snowfall	Hot Spot	10ft Sea Level Rise
15	Cobble Hill Apartments	Elder Housing	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	Yes	No
16	Cobble Hill Apartments	Elder Housing	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	Yes	No
17	Cobble Hill Apartments	Elder Housing	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	Yes	No
18	Cobble Hill Apartments	Elder Housing	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	Yes	No
19	Mount Pleasant Apartments	Elder Housing	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	No
20	Elizabeth Peabody House	Child Care	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
21	Mulberry Child Care	Child Care	Low incidence	No	H 48.1 - 72.0	Yes	No
22	Tufts Educational Day Care Center	Child Care	Low incidence	No	H 48.1 - 72.0	Yes	No
23	Cambridge Economic Opportunity Committee Preschool	Child Care	Low incidence	No	H 48.1 - 72.0	Yes	No
24	Bright Future Day Care	Child Care	Low incidence	No	H 48.1 - 72.0	No	No
25	YMCA Pre-school	Child Care	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
26	YMCA After School Program	Child Care	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
27	Peabody Ames Child Care	Child Care	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No

ID	Name	Type	Landslide Risk	FEMA Flood Zone	Average_ Annual Snowfall	Hot Spot	10ft Sea Level Rise
28	Learning Center Pre-school	Child Care	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
29	Primary Emergency Operations Center	Police Station	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	Yes
30	East Somerville Community School	School	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	No
31	MWRA Sewer Pump Station	Sewer Pump Station	Low incidence	AE: 1% Annual Chance of Flooding	H 48.1 - 72.0	No	Yes
32	MWRA Pump Station Shaft 9	Water Pump Station	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
33	MWRA Chemical Vault	Hazardous Material Site	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	Yes
34	NSTAR Substation	Power Substation	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
35	NSTAR Substation	Power Substation	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
36	NSTAR Substation	Power Substation	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	Yes
37	NSTAR Substation	Power Substation	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	Yes
38	NSTAR Substation	Power Substation	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	No

ID	Name	Type	Landslide Risk	FEMA Flood Zone	Average_ Annual Snowfall	Hot Spot	10ft Sea Level Rise
39	NSTAR Substation	Power Substation	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	Yes	Yes
40	NSTAR Substation	Power Substation	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	Yes
41	NSTAR Substation	Power Substation	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	No
43	Home Depot	Place of Assembly	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	Yes
44	LaQuinta Inn	Hotel	Moderate susceptibility and low incidence	X: 0.2% Annual Chance of Flooding	G 36.1 - 48.0	No	Yes
45	Holiday Inn	Hotel	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	Yes
46	Amtrak Commuter Rail Maintenance	Transportation Facility	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	Yes
47	Rail Distribution Center	Transportation Facility	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	No
49	Verizon Central Office	Telecommunications Switching Station	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
50	Rogers Foam Corporation	Hazardous Material Site	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
51	Cambridge Health Alliance	Hazardous Material Site	Low incidence	No	H 48.1 - 72.0	No	No
52	Pearson/Michaels Chemical Laboratory	Hazardous Material Site	Low incidence	No	H 48.1 - 72.0	Yes	No

ID	Name	Type	Landslide Risk	FEMA Flood Zone	Average_ Annual Snowfall	Hot Spot	10ft Sea Level Rise
53	Powder House Community School	School	Low incidence	No	H 48.1 - 72.0	Yes	No
54	Author D. Healey School	School	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
55	Somerville Vocational High School	School	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	No
56	Capuano Early Education Center	School	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	Yes
57	Benjamin Brown School	School	Low incidence	No	H 48.1 - 72.0	No	No
58	Tufts University Campus	School	Low incidence	No	H 48.1 - 72.0	No	No
59	Properzi Manor	Elder Housing	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	No
60	Bryant Manor	Elder Housing	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	No
61	Monmouth Street	Special Needs	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
62	Corbett	Elder Housing	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
63	Prospect House	Special Needs	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
64	Ciampa Manor	Elder Housing	Low incidence	No	H 48.1 - 72.0	Yes	No
65	Clarendon Hill Towers	Elder Housing	Low incidence	No	H 48.1 - 72.0	No	No
66	Capen Court Apartment Building	Elder Housing	Low incidence	No	H 48.1 - 72.0	Yes	No
67	Teen Connection	Medical Facility	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No

ID	Name	Type	Landslide Risk	FEMA Flood Zone	Average_ Annual Snowfall	Hot Spot	10ft Sea Level Rise
68	Somerville Section Eight House	Public Housing	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
69	District Attorney's Office	Court House	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	Yes
70	Ralph & Jenny Memorial Center	Elder Housing	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	Yes
72	Hutchins Transitional Care	Elder Housing	Low incidence	No	H 48.1 - 72.0	No	No
73	Argenziano at Lincoln Park	School	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	Yes
74	Caas Head Start-Boys and Girls Club	Child Care	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	No
75	Cummings School	School	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
76	Somerville Armory	Arts at the Armory	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
77	Somerville High School	School	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
78	Winter Hill Community School	School	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
79	West Somerville Library	Library	Low incidence	No	H 48.1 - 72.0	Yes	No
80	Police Academy Training Center	Police Station	Low incidence	No	H 48.1 - 72.0	Yes	No
81	Saltonstall Senior	Elder Housing	Low incidence	No	H 48.1 - 72.0	Yes	No
82	West Somerville Neighborhood School	School	Low incidence	No	H 48.1 - 72.0	Yes	No

ID	Name	Type	Landslide Risk	FEMA Flood Zone	Average_ Annual Snowfall	Hot Spot	10ft Sea Level Rise
83	Central Street Health Center	Urgent Care	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
84	Cambridge Health Alliance	Hospital	Low incidence	No	H 48.1 - 72.0	No	No
85	Secondary Emergency Operations Center	Emergency Operations Center	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
86	Somerville District Court	Court House	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	Yes
87	Blessing of the Bay Boathouse	Municipal	Moderate susceptibility and low incidence	X: 0.2% Annual Chance of Flooding	H 48.1 - 72.0	No	Yes
88	Ellis Oval Stadium	Place of Assembly	Low incidence	AE: Regulatory Floodway	H 48.1 - 72.0	Yes	Yes
89	Engine 4 & Tower 1 Fire Station	Fire Station	Low incidence	No	H 48.1 - 72.0	No	No
90	Somerville Fire Department HQ, 266 Broadway	Fire Station	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
91	Engine 7 Fire Station	Fire Station	Low incidence	No	H 48.1 - 72.0	No	No
92	Engine 6 & Ladder 3 Fire Station	Fire Station	Low incidence	No	H 48.1 - 72.0	Yes	No
93	Engine 3 Fire Station	Fire Station	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	Yes
94	Police Station	Police Station	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	Yes
95	City Hall	Municipal	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
96	Dept. of Public Works/Fire Prevention	Public Works Facility/Fuel Distribution Center/Fire Prevention Bureau	Low incidence	No	H 48.1 - 72.0	No	No

ID	Name	Type	Landslide Risk	FEMA Flood Zone	Average_ Annual Snowfall	Hot Spot	10ft Sea Level Rise
97	Fire Station, 6 Newbury St.	Fire Station	Low incidence	No	H 48.1 - 72.0	Yes	No
98	Prospect Hill Academy	School	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	Yes
99	St. Anthony's School	School	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
100	Prospect Hill Academy	School	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	No
101	St. Catherine's School	School	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
102	Full Circle High School	School	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	No
103	Edgerly Education Center	School	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	No
104	Next Wave Junior High School	School	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	No
105	John F. Kennedy School	School	Low incidence	No	H 48.1 - 72.0	No	No
106	St. Ann Elementary School	School	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
107	Somerville Theatre	Place of Assembly	Low incidence	No	H 48.1 - 72.0	Yes	No
108	70 Inner Belt Road	Hazardous Material Site	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	Yes
109	Tufts Administration Building (TAB)	Child Care	Low incidence	No	H 48.1 - 72.0	Yes	No
110	Harvard Vanguard Medical Facility Associates	Medical Facility	Low incidence	No	H 48.1 - 72.0	Yes	No

ID	Name	Type	Landslide Risk	FEMA Flood Zone	Average_ Annual Snowfall	Hot Spot	10ft Sea Level Rise
112	Assembly Square Market Place	Place of Assembly	Moderate susceptibility and low incidence	X: 0.2% Annual Chance of Flooding	G 36.1 - 48.0	No	Yes
113	Somerville Boxing Club	Place of Assembly	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	No
114	Dilboy Stadium	Place of Assembly	Low incidence	AE: Regulatory Floodway	H 48.1 - 72.0	Yes	Yes
115	Veterans Memorial Skating Rink	Place of Assembly	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
116	Angelica Laundry Mat	Hazardous Material Site	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	Yes
117	Visiting Nurse Association (Alewife Brook)	Elder Housing	Low incidence	No	H 48.1 - 72.0	Yes	No
119	Jeanne Jugan Residence	Elder Housing	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
120	Somerville Public Library (Main Branch)	Place of Assembly	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	No
121	Somerville Public Library (East Branch)	Place of Assembly	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	No
122	City Hall Annex	Municipal	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
123	East Somerville Police Sub-Station	Police Station	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	No

ID	Name	Type	Landslide Risk	FEMA Flood Zone	Average_ Annual Snowfall	Hot Spot	10ft Sea Level Rise
124	Clarendon Hill Apartments	Municipal	Low incidence	No	H 48.1 - 72.0	No	No
125	Kesher Hebrew School	Child Care	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
127	Mystic 1 & 2	Child Care	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
128	Mystic Three	Child Care	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
130	Somerville Early Head start	Child Care	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
132	CAAS Head start	Child Care	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	Yes
133	Somerville Child Care Center	Child Care	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
134	Open Center for Children	Child Care	Low incidence	No	H 48.1 - 72.0	No	No
135	Bellas Manitas Learning Center	Child Care	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	No
137	435 Washington St. Common	Child Care	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	Yes
140	Agassiz Pre-School	Child Care	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
141	Pooh and Friends	Child Care	Moderate susceptibility	No	H 48.1 - 72.0	No	No
2	Clarendon Hill Towers	Mixed Housing	Low incidence	No	H 48.1 - 72.0	No	No
144	CHA Somerville Urgent Care	Urgent Care Facility	Low incidence	No	H 48.1 - 72.0	No	No

ID	Name	Type	Landslide Risk	FEMA Flood Zone	Average_ Annual Snowfall	Hot Spot	10ft Sea Level Rise
145	12 Tyler Street	Child Care	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	Yes
146	Bright Future	Child Care	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	Yes
147	Bigelow Coop	Child Care	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	Yes
148	Parks & Crafts	Child Care	Moderate susceptibility and low incidence	No	H 48.1 - 72.0	No	No
149	Bright Horizons	Child Care	Low incidence	No	H 48.1 - 72.0	Yes	No
150	Dandelion Montessori Day Care	Child Care	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	No
151	Little Footprints	Child Care	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	No
152	Community Pre-school	Child Care	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	No
153	Mass General Childcare	Child Care	Moderate susceptibility and low incidence	X: 0.2% Annual Chance of Flooding	G 36.1 - 48.0	No	Yes
154	Diki Shining Star	Child Care	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	Yes
155	Parenting Journey	Child Care	Moderate susceptibility and low incidence	No	G 36.1 - 48.0	No	Yes

VULNERABILITY ASSESSMENT

The purpose of the vulnerability assessment is to estimate the extent of potential damages from natural hazards of varying types and intensities. A vulnerability assessment and estimation of damages was performed for hurricanes, earthquakes, and flooding through the HAZUS-MH software.

Introduction to HAZUS-MH

HAZUS- MH (multiple-hazards) is a computer program developed by FEMA to estimate losses due to a variety of natural hazards. The following overview of HAZUS-MH is taken from the FEMA website. For more information on the HAZUS-MH software, go to https://www.fema.gov/hazus/

> "HAZUS-MH is a nationally applicable standardized methodology and software program that contains models for estimating potential losses from earthquakes, floods, and hurricane winds. HAZUS-MH was developed by the Federal Emergency Management Agency (FEMA) under contract with the National Institute of Building Sciences (NIBS). Loss estimates produced by HAZUS-MH are based on current scientific and engineering knowledge of the effects of hurricane winds, floods, and earthquakes. Estimating losses is essential to decision-making at all levels of government, providing a basis for developing and evaluating mitigation plans and policies as well as emergency preparedness, response, and recovery planning.
>
> HAZUS-MH uses state-of-the-art geographic information system (GIS) software to map and display hazard data and the results of damage and economic loss estimates for buildings and infrastructure. It also allows users to estimate the impacts of hurricane winds, floods and earthquakes on populations."

There are three modules included with the HAZUS-MH software: hurricane wind, flooding, and earthquakes. There are also three levels at which HAZUS-MH can be run. Level 1 uses national baseline data and is the quickest way to begin the risk assessment process. The analysis that follows was completed using Level 1 data. Level 1 relies upon default data on building types, utilities, transportation, etc. from national databases as well as census data. While the databases include a wealth of information on the City of Somerville, it does not capture all relevant information. In fact, the HAZUS training manual notes that the default data is "subject to a great deal of uncertainty."

However, for the purposes of this plan, the analysis is useful. This plan is attempting to generally indicate the possible extent of damages due to certain types of natural disasters and to allow for a comparison between different types of disasters. Therefore, this analysis should be considered to be a starting point for understanding potential damages from the hazards.

ESTIMATED DAMAGES FROM HURRICANES

The HAZUS software was used to model potential damages to the community from a 100-year and 500-year hurricane event; storms that are 1% and 0.2% likely to happen in a given year, and roughly equivalent to a Category 2 and Category 4 hurricane. The damages caused by these hypothetical storms were modeled as if the storm track passed directly through the city, bringing the strongest winds and greatest damage potential.

Though there are no recorded instances of a hurricane equivalent to a 500-year storm passing through Massachusetts, this model was included in order to present a "worst case scenario" that would help planners and emergency personnel evaluate the impacts of storms that might be more likely in the future, as we enter into a period of more intense and frequent storms.

Table 34: Estimated Damages from Hurricanes

	Category 2	Category 4
Building Characteristics		
Estimated total number of buildings	15,413	
Estimated total building replacement value (2014 $)	$9,355,379	
Building Damages		
# of buildings sustaining minor damage	521	2,648
# of buildings sustaining moderate damage	87	677
# of buildings sustaining severe damage	5	52
# of buildings destroyed	0	5
Population Needs		
# of households displaced	4	288
# of people seeking public shelter	3	141
Debris		
Building debris generated (tons)	7,604	30,372
Tree debris generated (tons)	816	2,221
# of truckloads to clear building debris	304	1,215
Value of Damages		
Property damage (buildings and content)	$48,562,870	$217,486,550
Losses due to business interruption	$3,847,150	$29,163.170
Total of All Losses	$52,410,020	$246,649,710

ESTIMATED DAMAGES FROM EARTHQUAKES

The HAZUS earthquake module allows users to define an earthquake magnitude and model the potential damages caused by that earthquake as if its epicenter had been at the geographic center of the study area. For the purposes of this plan, two earthquakes were selected: magnitude 5.0 and a magnitude 7.0. Historically, major earthquakes are rare in New England, though a magnitude 5 event occurred in 1963.

Table 35: Estimated Damages from Earthquakes

	Magnitude 5.0	Magnitude 7.0
Building Characteristics		
Estimated total number of buildings	15,413	
Estimated total building replacement value (2014 $)	$9,355,379	
Building Damages		
# of buildings sustaining slight damage	4,191	280
# of buildings sustaining moderate damage	2,959	800
# of buildings sustaining extensive damage	1,172	2,519
# of buildings completely damaged	348	8,639
Population Needs		
# of households displaced	2,857	23,178
# of people seeking public shelter	1,575	12,837
Debris		
Building debris generated (tons)	403,000	2,579,000
# of truckloads to clear debris (@ 25 tons/truck)	16,120	103,160
Value of Damages		
Property damage (buildings and contents)	$1,367,964,000	$1,492,991
Losses due to business interruption	$303,922,500	$8,882,111
Total of All Losses	$1,671,890,000	$10,375,100

ESTIMATED DAMAGES FROM FLOODING

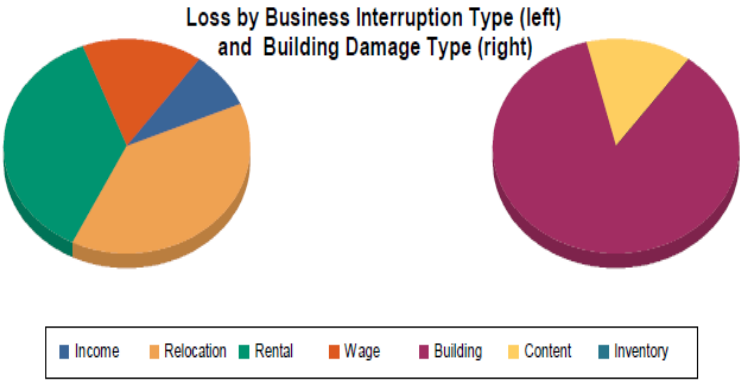
The HAZUS flooding module allows users model the potential damages caused by a 100-year flood event and a 500-year flood event.

Table 36: Estimated Damages from Flooding

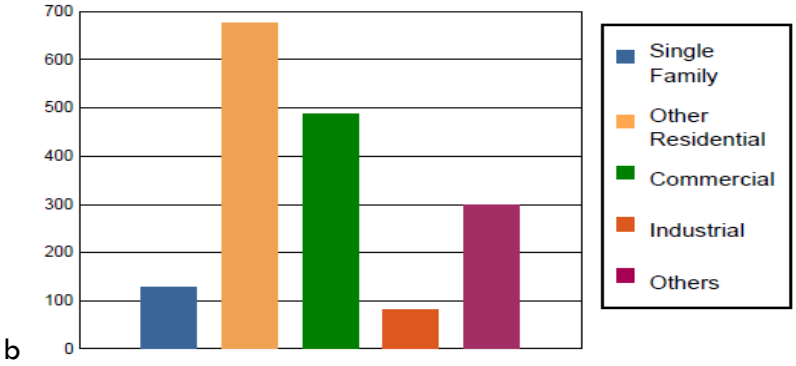
	100-Year Flood	500-Year Flood
Building Characteristics		
Estimated total number of buildings	15,413	
Estimated total building replacement value (2014 $)	$9,355,379	
Building Damages		
# of buildings sustaining limited damage	92	130
# of buildings sustaining moderate damage	0	0
# of buildings sustaining extensive damage	0	0
# of buildings substantially damaged	0	0
Population Needs		
# of households displaced	523	550
# of people seeking public shelter	90	97
Value of Damages		
Building Losses	$37,480,000	$45,550,000
Losses due to business interruption	$90,670,000	$ 96,630,000
Total of All Losses	$127,440,000	$142,190,000

Figure 25: HAZUS Loss Estimates by Type

23-A Hurricane Loss by Business and Occupancy Type

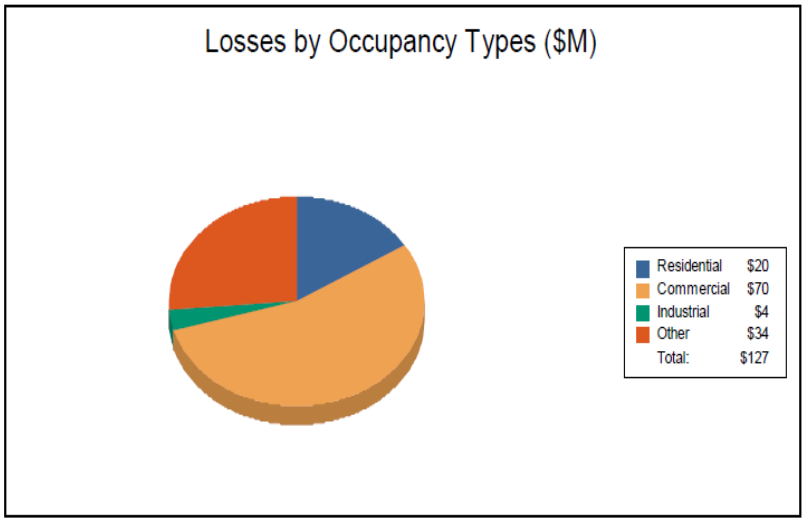


23-B Earthquake Loss by Occupancy Type



b

23-C Flood Loss by Occupancy Type



IMPACTS ON PEOPLE AND VULNERABLE POPULATIONS

Just as some locations in Somerville will be more vulnerable to climate impacts than others, it is also true that climate change and natural hazards will not affect all residents of Somerville equally. People who may be more susceptible to negative health effects can include older adults, young children, pregnant women, people with disabilities, and people with pre-existing health conditions, as they are more likely to be physically vulnerable to the health impacts of extreme heat and poor air quality. Individuals with physical mobility constraints may need additional assistance with emergency response. Older adults are often at elevated risk due to a high prevalence of pre-existing and chronic conditions. People who live in substandard housing and in housing without air conditioning have increased vulnerability to heat-related illnesses. Black and Latino residents in Massachusetts are hospitalized for asthma at considerably higher rates than the population as whole, reflecting the reality that longstanding societal inequities can lead to differential health outcomes based on race and ethnicity.

Low-income people are often more susceptible to financial shocks, which can occur after extreme weather, and which can impact financial security and the ability to secure safe shelter and meet medical needs. Social isolation can also influence vulnerability, as it limits access to critical information, municipal resources, and social support systems. In the absence of strong social support networks and translation services, people living alone and those with limited English language proficiency may experience social isolation. People of color and undocumented immigrants may also experience social isolation where there are historically strained or tenuous relationships with government officials and first responders. Certain occupations may also experience more severe impacts. People who work outdoors, or in unregulated temperatures, are at increased risk for heat-related illnesses.

Renters are also more vulnerable to natural hazards. The City of Somerville has provided the following description of renter vulnerability (see notes on this text in Section 10, References and Notes):

> "The Commonwealth's first building code for new construction was promulgated in 1975. About 82 percent (27,633) of housing units in[1] Somerville were constructed prior to 1970, before the first building code was enacted. Even before the global COVID-19 pandemic, Americans[2] spent an estimated 70 percent of their time inside their homes. According[3] to in-house surveys, apartments in Somerville are reportedly, in general, in "ill repair" and a majority of landlords do not pay for tenants' utilities[4]. Aging homes pose potential health and safety hazards for occupants. They also lack energy-efficient features [5,6] that help tenants save on utility costs. Studies have shown that low-income households have higher energy costs [7] that are disproportionate to the amount of energy they are using. This "reflects the fact that energy use is a[8] necessity and does not change proportionately when incomes rise or fall. But the larger cost burden on low-income renters also arises from the lower energy efficiency of their housing..." As a result, "tenants are burdened with[9]

living in less efficient and less comfortable homes while paying higher utility bills."[10] New data from the Energy Information Administration describes the initial impact of the global COVID-19 pandemic on U.S. residential electric customers. In April 2020, residential sales increased six percent compared to the past five years, suggesting monetary implications for vulnerable households spending more time at home."

"According to an in-house survey by the Housing Division for the 2017 Assessment of Fair Housing, respondents reported experiencing housing discrimination. Reportedly, discrimination has led to families subletting[11] substandard spaces. Contributing factors to housing discrimination may include:[12]

- the lack of enforcement of the law;
- apartments in poor condition;
- a limited knowledge of tenant rights on the parts of both tenants and landlords;
- a lack of information available in languages other than English. [13]

Respondents also expressed reluctance to report their landlords for discrimination for fear of retaliation. This fear may extend to code violations."

In developing mitigation measures the City will need to consider the needs of all of its residents. In Somerville 11.1% of residents are below the poverty level (4-person household earning less than $24,563). Over 12% of residents are limited English speakers, and 32% speak a language other than English at home. Residents over age 65 represent nearly 10% of the City's population, and 8% have a disability. (American Community Survey, 2019).

RISK ASSESSMENT SUMMARY

CLIMATE CHANGE	NATURAL HAZARD	PRIORITY (H/M/L)	KEY CONCERNS SOCIETY	KEY CONCERNS BUILT ENVIRONMENT	KEY CONCERNS NATURAL RESOURCES
Changes in Precipitation 	Inland Flooding	High	Elderly residents and environmental justice populations; property damage; Impacts on businesses	Roadway closures , damage to buildings; impacts on infrastructure	Pollutants, scouring
	Drought	Medium	Increases costs for irrigation, drinking water supply	Impacts on landscaped areas, parks, playing fields, etc.	Impacts on streams, wetlands, vegetation
	Landslide	Low	Private property damage	Damage to buildings and infrastructure	Erosion, sedimentation
Sea Level Rise 	Coastal Flooding	Medium	Property damage, impacts on businesses	Roadway closures , damage to buildings; impacts on infrastructure	NA
	Coastal Erosion	NA	NA	NA	NA
	Tsunami	Low	Property damage, loss of life	Damage to buildings and infrastructure	Damage to habitat
Rising Temperatures 	Average and Extreme Temperatures	High	Elderly populations if no access to cooling or financial resources to buy an AC		Increasing invasives, stress on resources
	Wildfires	Low	Air Quality - Smoke	Damage to buildings	Damage to resources
	Invasive species	Low	Potential health impacts of pests	Impaired use of park and open space	Loss of biodiversity
Extreme Weather 	Hurricanes / Tropical Storms	High	Power outages; property damage, impacts to businesses	Street closures, house flooding, emergency access, wind damage to buildings, power outages	Tree damage
	Severe Winter Storms	High	Power outages, elderly, or isolated residents	Damage to public buildings with snow loads, power outages that can affect municipal operations, road blockages.	Tree damage
	Tornadoes	Low	Property damage, impacts on businesses	Damage to buildings and infrastructure	Tree damage
	Other (Wind/ Thunderstorms/ Microbursts)	Med-High	Power outages, property damage	Power loss, road closures (same as above)	Tree damage
Non-Climate Hazard	Earthquake	Low	Property damage, impacts on businesses	Damage to buildings and Infrastructure	

SECTION 5: HAZARD MITIGATION GOALS

The Somerville Local Hazard Mitigation Planning Team reviewed and discussed the goals from the 2016 Hazard Mitigation Plan. All of the goals are considered critical for the city, and they are not listed in order of importance. Prior to this Hazard Mitigation Plan update process, the City of Somerville developed a Climate Change Vulnerability in 2017. The local team chose to incorporate climate and equity considerations as noted in Goals 10 and 11.

1. Prevent and reduce the loss of life, injury and property damages resulting from natural hazards.
2. Identify and seek funding for measures to mitigate or eliminate each known significant flood hazard area.
3. Integrate hazard mitigation planning as an integral factor in all relevant municipal departments, committees, and boards.
    - ☐ Ensure that the Planning Department considers hazard mitigation in its review and permitting of new development.
    - ☐ Review zoning regulations to ensure that the ordinance incorporates all reasonable hazard mitigation provisions.
    - ☐ Ensure that all relevant municipal departments have the resources to continue to enforce codes and regulations related to hazard mitigation.
4. Prevent and reduce the damage to public infrastructure resulting from all hazards.
    - ☐ Begin to assess the vulnerability of municipal buildings and infrastructure to damage from an earthquake.
    - ☐ Maintain existing mitigation infrastructure in good condition.
5. Encourage the business community, major institutions, and non-profits to work with the City to develop, review and implement the hazard mitigation plan.
6. Work with surrounding communities, state, regional and federal agencies to ensure regional cooperation and solutions for hazards affecting multiple communities.
    - ☐ Participate in the Metro Mayors Climate Task Force and the Resilient Mystic Collaborative to address regional hazards and mitigation.
7. Ensure that future development meets federal, state, and local standards for preventing and reducing the impacts of natural hazards.
8. Educate the public about natural hazards and mitigation measures that can be undertaken by property-owners.
    - ☐ Provide information on hazard mitigation activities in the languages most frequently spoken in Somerville.
9. Take maximum advantage of resources from FEMA and MEMA to educate City staff and the public about hazard mitigation.
10. Consider the impacts of climate change and incorporate climate sustainability and resiliency into the City's planning and policies.
11. Prioritize equity in all aspects in all aspects of Hazard Mitigation planning and implementation.

SECTION 6: EXISTING MITIGATION MEASURES

The existing protections in the City of Somerville are a combination of zoning, land use, and environmental regulations, infrastructure maintenance, and drainage infrastructure improvement projects. Infrastructure maintenance generally addresses localized drainage clogging problems, while large scale capacity problems may require pipe replacement or invert elevation modifications. These more expensive projects are subject to the capital budget process and lack of funding is one of the biggest obstacles to completion of some of these.

The City's existing mitigation measures are listed by hazard type here and are summarized in Table 36 below. Upgrades to existing measures and new measures are noted as well.

Multi-Hazard Mitigation Measures

Massachusetts State Building Code – The City enforces the Massachusetts State Building Code. The State Building Code contains detailed regulations regarding multiple hazards, including earthquakes, snow loads, and wind loads.

Flood Hazard Mitigation Measures

Participation in the National Flood Insurance Program - FEMA maintains a database on flood insurance policies and claims. The reporting period covers January 1, 1978, through September 15, 2021. The following information is provided for the City of Somerville.

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Flood insurance policies in force (as of January 31, 2015)	58
Coverage amount of flood insurance policies	$16,588,000
Premiums paid	$ 26,214
Closed losses (Losses that have been paid)	29
Total payments (Total amount paid on losses)	$ 889,805

Descriptions of city mitigation programs can be found at: www.somervillema.gov/floodready

Sacramento Street Pedestrian Tunnel – This is where the City installed new pumps to alleviate flooding in 2006. New pumps continue to operate well with no issues.

Somerville Avenue – Due to past flooding along the corridor between Porter and Union Squares, a relief drain project was implemented. The project is now complete from the Cambridge Line to Union Square. The remaining portion of the program is ongoing from Union Square to McGrath Highway (Rt. 28) to address additional flooding concerns.

Valve Turner – At the time of the previous plan, the City purchased a valve turner in order to implement a program of valve exercising. Work is still occurring, and the City is using the valve machine, which is mobile and can be transported around City.

Catch basin cleaning – The City maintains a map of "storm-challenged" catch basins. When a storm is forecast, the DPW goes out and checks the grates on these catch basins to ensure that there is no debris clogging the gate. Catch basin cleaning is done by city personnel. The city occasionally contracts out for services in order to catch up if there is a back log of basins that need to be cleaned. The City has also purchased a new Vactor Truck to improve equipment used in cleaning. Catch basin cleaning is currently performed according to the requirements of the MS4 Stormwater Permit issued to the City by the Environmental Protection Agency.

Street sweeping – Street sweeping is still occurring although daytime sweeping is now performed through a contract with a private provider. City staff still sweeps major corridors over night during the week. The City also has machines that it uses for sidewalk sweeping. Street sweeping is currently performed according to the requirements of the MS4 Stormwater Permit issued to the City by the Environmental Protection Agency.

Zoning Overhaul - A new zoning ordinance was passed by the City Council in 2019, establishing requirements for development to better align with the city's sustainability and climate goals. Some of the most notable changes are:

• Requirements for buildings over 25,000 square feet to be LEED Gold certifiable and for buildings over 50,000 square feet to be LEED Platinum certifiable.

• Developers will be allowed to increase the unit count of their buildings if they meet Net Zero Ready requirements.

• The new zoning sets ambitious green building standards in Master Planned Overlay Districts. This allows for larger development projects in exchange for designing buildings to meet stringent energy efficiency standards, installing a green roof and/or solar on their roof.

• The zoning ordinance also established New England's first environmental sustainability performance standard for urban landscapes: the Somerville Green Score

Floodplain Overlay District - The purpose of this district is to ensure public safety through reducing threats to life, personal injury, and property from flooding. All development within the overlay district must be in compliance with Chapter 131, Section 40 of the Massachusetts General Laws and Section 2102 of the Mass. State Building Code. The district encompasses all special flood hazard areas designated on the FIRM maps issued by FEMA, which are currently dated June 10, 2010. The City will update the Floodplain Overlay District when the next series of FIRM maps are adopted by FEMA.

Dam Mitigation Measures

Outfall Projects - There are no dams owned or operated by the City, although the Amelia Earhart dam is partially within the City limits. The city has installed a stormwater outfall in the vicinity of the Earhart Dam, but this does not impact the dam.

Since the 2016 Hazard Mitigation Plan, the City prepared the Climate Change Vulnerability Assessment, which evaluates the potential for flood waters flanking the Amelia Earhart dam due to the impacts of Sea Level Rise and storm surges. The dam is owned and operated by the MA Department of Conservation and Recreation, and the City is advocating with regional partners for mitigation of this potential flood risk.

Wind Hazard Mitigation Measures

Tree trimming program - The DPW trims trees and tree plantings are performed by the Conservation Commission. The City is currently posting for a Tree Warden. The previous plan noted that the City had purchased a forestry truck. Since then, the City has adopted an Urban Forestry Plan and has implemented a Treekeeper Analysis and a tree planting program. See the description of the Urban Forestry Plan below, after Table 37.

Massachusetts State Building Code – The City enforces the Massachusetts State Building Code. The Massachusetts State Building Code contains detailed regulations regarding wind loads. The code's provisions are the most cost-effective mitigation measure against tornados given the extremely low probability of occurrence.

Winter Storm Hazard Mitigation Measures

Extreme Heat—The City provides cooling centers and public education on heat hazards. *Since the previous plan the City has implemented several measures to address extreme heat, including the Keep Cool small grants program, HeatSmart CoolSmart. Descriptions of city mitigation programs can be found at:* www.somervillema.gov/sustainaville*, and* www.somervillema.gov/r2nz

Underground utilities **-** The City had a plan to put the utilities along Beacon Street underground. However, this was not found to be cost effective. Underground utilities may be more feasible where new streets are being constructed. The City will focus on that approach.

Existing Geologic Hazard Mitigation Measures

Massachusetts State Building Code **–** The State Building Code contains a section on designing for earthquake loads (780 CMR 1612.0). Section 1612.1 states that the purpose of these provisions is "to minimize the hazard to life to occupants of all buildings and non-building structures, to increase the expected performance of higher occupancy structures as compared to ordinary structures, and to improve the capability of essential facilities to function during and after an earthquake." Due to the complexity of seismic design, the criteria presented are the minimum considered to be "prudent and economically justified" for the protection of life safety. The code

also states that absolute safety and prevention of damage, even in an earthquake event with a reasonable probability of occurrence, cannot be achieved economically for most buildings.

Fire Hazard Mitigation Measures

Ban on outdoor burning – The City has a prohibition on outdoor burning.

Development review –The Fire Department is involved in reviewing new developments.

MITIGATION CAPABILITIES AND LOCAL CAPACITY FOR IMPLEMENTATION

Under the Massachusetts system of "Home Rule," the City of Somerville is authorized to adopt and from time to time amend local ordinances and regulations that support the city's capabilities to mitigate natural hazards. These include Zoning Ordinances, Subdivision and Site Plan Review Regulations, Wetlands Ordinance, Health Regulations, Public Works regulations, and local enforcement of the State Building Code. Local Ordinances may be amended by the City Council to improve the city's capabilities, and changes to most regulations simply require a public hearing and a vote of the authorized board or commission. The City of Somerville has recognized several existing mitigation measures that require implementation or improvements and has the capacity within its local boards and departments to address these.

The City can improve its hazard mitigation capabilities with the following measures:

• Review and update the Low Impact Development best practices in the Town's LID guidelines and consider incorporating LID requirements more formally into a bylaw to ensure it becomes widely adopted in new developments and redevelopments.

• The City can update the Floodplain Ordinance to incorporate the next iteration of the Flood Insurance Rate Maps.

• The City can consider participating in the Community Rating System to enhance its mitigation capabilities while provide reduced flood insurance rates to residents and businesses.

• When preparing the City's next Master Plan, incorporate Hazard Mitigation and Climate Resilience as a formal component of the plan, equivalent to other components traditionally included in a Master Plan such as Land Use, Transportation, Housing, and Economic Development.

• When preparing the City's next Open Space and Recreation plan, incorporate Hazard Mitigation and Climate Resilience as a formal component of the plan. Identify opportunities for open space protection and land acquisition that would have specific hazard mitigation co-benefits, such as managing stormwater to reduce flooding, protecting vegetation for shade to mitigate extreme heat, and managing wetlands and tree canopy to mitigate climate impacts.

• Expand the City's tree trimming operations, in coordination with the utilities, to reduce vulnerability to high winds and winter storms and the City's risk of power outages.

• In reviewing and permitting new development projects, refer to the Hazard Mitigation Plan for guidance to incorporate mitigation into site design and construction.

• Review and update the Town's water conservation plan to enable a more robust mitigation of drought, which has occurred more frequently in the last decade and is projected to increase in the future due to climate change.

• Take advantage of opportunities to collaborate on regional mitigation issues such as potential flooding impacts of the Amelia Earhart Dam and potential flooding from the Schrafft Center area of Charlestown. Regularly coordinate with the Metro Mayors Climate Task Force and the Resilient Mystic Collaborative to work with neighboring cities and state agencies such as DCR to address issues beyond the borders of the City that could impact Somerville.

• Financing the implementation of mitigation measures: the City can incorporate a program of its highest priority mitigation measures into its Capital Investment Program to ensure that these receive priority along with other categories of municipal investment such as roadways and municipal buildings.

• Consider adopting a Stormwater Utility or stormwater user fee to provide a dedicated, predictable revenue stream to finance upgrades to the stormwater infrastructure, many of which are needed to mitigate flooding risks.

• The City can complete an assessment of and culverts that are vulnerable to flooding and drainage problems and prioritize drainage upgrades for implementation.

Figure 26: Success Story: Stormwater Management in Parks

SUCCESS STORY

STORMWATER MANAGEMENT: PARKS MATTER

IN SOMERVILLE, LIKE ALL densely populated cities with high percentages of impermeable surfaces, the problems created by stormwater runoff are becoming more urgent as the frequency of intense storms increases. Minimizing stormwater runoff, controlling flooding, and eliminating pollutants that are carried to regional water bodies are important goals for planners and engineers. One of the tools for achieving these goals are innovative retention and catchment features in parks and open spaces.

Chuckie Harris Park (CHP), a PARC grantee completed in 2013, captures all stormwater runoff in lush rain gardens that run the length of the park. The park increased the permeability of the site sixfold, and added 70 water-absorbing (and air cleaning) trees. In addition, the water generated from the low-flow water feature travels into an underground pipe where it passively waters street trees.

Symphony Park, also a PARC grantee located in East Somerville, and completed in 2015, contains an underground storage tank with a 2,000 gallon capacity. This hidden infrastructure helps the environment in two ways: 1) it captures and recirculates stormwater and water from the low-flow water feature for irrigation (which means less water used from municipal supplies) and 2) it holds 2,000 gallons of water during severe storms. Capturing and slowing rainwater is an important way to ameliorate flooding, minimize pollutants in our waterways and recharge our groundwater supply.

In addition to these features, there are underground retention basins at North St Veterans Playground (PARC grantee), Marshall Street Playground (Our Common Back Yard grantee) and Ed Leathers Community Park (Urban Self Help grantee). Lincoln Park (PARC grantee) and Nunziato Field are two planned projects with large stormwater retention infrastructure (1.25 million gallons at each site). Somerville parks are not only beautiful, they are also doing important work.

This page: Stormwater retention chambers were included in the redesign of both Symphony and Lincoln Park.

Opposite: The raingardens that run along Chuckie Harris Park capture and filter stormwater.

Source: Somerville Climate Forward, 2019 Progress Report

COMPILATION OF EXISTING MITIGATION

Table 37 summarizes the City's many existing natural hazard mitigation measures and notes any changes or updates since the previous 2016 plan. The city will continue to build on this list of mitigation measures as it implements this plan over the next five years.

Table 37: Existing Natural Hazard Mitigation Measures in Somerville

Mitigation Measure	Area Covered	Effectiveness	Updates for 2022
MULTIPLE HAZARDS			
Massachusetts State Building Code	City-wide.	Effective for new construction. Many buildings in the City pre-date the most recent, more stringent code.	The City has adopted the Stretch Code
FLOOD HAZARDS			
Participation in the National Flood Insurance Program.	Flood hazard areas on FIRM maps.	Effective for owners who participate in the program. However, many areas that flood are not in floodplain zones.	Encourage greater participation amongst eligible property-owners. Consider enrolling in the Community Rating System
Sacramento Street Foot Bridge pumps	Local area only.	Effective.	Project has been completed; pumps are operating effectively
Somerville Avenue storm drain project.	Somerville Avenue.	Effective	Significant portion of project constructed between Porter and Union Squares
Valve exercising	City-wide.	Effective. Operating well and mobile for use around city.	No changes

Mitigation Measure	Area Covered	Effectiveness	Updates for 2022
Catch basin cleaning.	City-wide.	Effective.	Catch basin cleaning performed as required by the MS4 Stormwater Permit
Street sweeping	City-wide.	Effective.	Street sweeping performed as required by the MS4 Stormwater Permit
Floodplain Overlay District	All special flood hazard areas designated on the FIRM maps issued by FEMA.	Effective.	Floodplain zoning was updated in 2019 with current FEMA Flood Insurance Rate Map
Outfall Projects	Outfall in vicinity of Amelia Earhart Dam, drains the Assembly Row area.	Effective.	No changes
WIND HAZARDS			
The Massachusetts State Building Code.	City-wide.	Effective for new development in most situations except the most severe storms.	The City has adopted the Stretch Code
Tree inventory and management	City-wide.	Effective. The City has posted a position for a Tree Warden	The city has adopted an Urban Forestry Plan and implemented a Treekeeper Analysis and a tree planting program.

Mitigation Measure	Area Covered	Effectiveness	Updates for 2022
WINTER HAZARDS			
Massachusetts State Building Code	City-wide.	Effective for new construction. Many buildings in the City pre-date the most recent, more stringent code.	The City has adopted the Stretch Code
Underground utilities	Beacon Street and city-wide.	Effective in the long-term.	Installation of underground utilities on Beacon Street was not cost effective. City to consider this when constructing new roads.
GEOLOGIC HAZARDS			
The Massachusetts State Building Code	City-wide.	Effective for new development for most situations	The City has adopted the Stretch Code
BRUSH FIRE HAZARDS			
Ban on outdoor burning	City-wide.	Effective.	No changes
Development review by Fire Dept.	City-wide.	Effective.	No changes
CLIMATE CHANGE			
Somerville Climate Vulnerability Assessment (2017)	City-wide.	Effective.	New since the 2016 plan. Addresses both inland and coastal flooding, heat, public health, vulnerable populations (see summary below)

Mitigation Measure	Area Covered	Effectiveness	Updates for 2022
Somerville Climate Forward Plan (2018)	City-wide.	Effective.	New since the 2016 plan. Action plan for both climate mitigation (GHG reduction) and resilience. Annual Reports are issued to track progress (see summaries below)
Keep Cool Somerville (2021)	City-wide	Effective	New since the 2016 plan. Implemented six community-based projects that address heat. See description below.
Urban Forestry Plan	City-wide	Effective	New since the 2016 plan. See description below
Resilient Mystic Collaborative (2021)	Boston, Chelsea, Everett, Revere, Somerville, Winthrop	Effective	New since the 2016 plan. See description below
The City has established several renewable energy and energy efficiency programs since 2016, including: • National Grid Community Initiative (2016 and 2017) – nationally recognized • HeatSmart CoolSmart – nationally recognized • Solarize Somerville • US DOE designated SolSmart Gold (highest level) – nationally recognized • Smart Streets (Eversource)	City-wide	Effective	No changes

Mitigation Measure	Area Covered	Effectiveness	Updates for 2022
For detailed descriptions see www.somervillema.gov/r2nz/#tab5			
The City has established the Community Choice Aggregation program	City-wide	Effective	No changes
The City has established a Climate Forward Ambassador Program	City-wide	Effective	No changes
The Housing Division has increased funding for income eligible households for heating system replacements to reflect the higher upfront cost of fuel switching/installing energy efficient systems	City-wide	Effective	No changes

SOMERVILLE'S MAJOR INITIATIVES SINCE THE 2016 PLAN

Since the previous Hazard Mitigation Plan was completed in 2016, the City of Somerville embarked on several major new initiatives to address climate change and natural hazards and to greatly increase the City's capacity to plan for and implement new mitigation measures. Each of these efforts is the subject of significant plans and publications which are referenced throughout this plan update and briefly summarized below.

1. Somerville Climate Change Vulnerability Assessment (2017)

Just one year after the last Hazard Mitigation Plan, the City prepared a comprehensive analysis of climate change impacts. The analysis addresses the following key priorities:

PRIORITY 1: Precipitation-based flooding will impact much more of Somerville than coastal flooding.

PRIORITY 2: Sea level rise and storm surge flooding associated with the flanking of the Amelia Earhart Dam may occur as early as 2035 if significant investment in infrastructure improvements are not made.

PRIORITY 3: The Schrafft Center flood pathway in Boston, north of Sullivan Square, is of immediate concern to Somerville. It has the potential to flood under a present-day extreme event.

PRIORITY 4: The Fire Department Headquarters and Emergency Operations Center and the Police Department Headquarters are both vulnerable to flooding, which presents significant challenges to both daily city operations and operations during an emergency event.

PRIORITY 5: The transportation system (including MBTA lines and stations, major roadways, evacuation routes, and bike paths) is highly vulnerable to all three climate hazards – coastal flooding, precipitation, and heat

PRIORITY 6: Union Square, Assembly Square, and the Inner Belt, Somerville's transformative economic development districts, are highly vulnerable to flooding impacts

PRIORITY 7: Temperature is a ubiquitous threat throughout the city and will be relatively more intense in some areas based on a combination of surface types, lack of vegetation and level of emissions

PRIORITY 8: Climate change presents the potential for serious public health impacts to vulnerable populations

PRIORITY 9: Open space and trees are highly valuable commodities to Somerville and need to be protected and enhanced.

The Climate Change Vulnerability Assessment is based on robust data, modeling, and mapping, and includes detailed analyses of these issues focusing on both neighborhood-level and city-wide issues and concerns as well as those with a regional focus. This forms the foundation for the Somerville Climate Forward Plan that was published the following year , described below.

2. Somerville Climate Forward Plan, 2018

Somerville Climate Forward provides a detailed road map for both short and long-term actions to address climate change impacts on the City. The plan includes strategies for both climate mitigation (i.e., reducing Greenhouse Gases) and climate resilience. The plan prioritizes the following 13 action areas, each of which is supported by key priority actions:

Action Area 1. Net-Zero and resilient new buildings standards
Action Area 2. Improving energy performance in existing buildings
Action Area 3. Equitable low-carbon mobility
Action Area 4. Rapid transition to electric vehicles
Action Area 5. Stormwater management
Action Area 6. Expanded tree canopy
Action Area 7. Reduced consumption and waste
Action Area 8. Healthy and resilient community
Action Area 9. Pathway to 100% renewable energy
Action Area 10. Culture of climate action
Action Area 11. City government leading by example
Action Area 12. State advocacy for carbon neutrality
Action Area 13. Regional Collaboration for coastal resilience

Key priority actions related to climate resilience that are closely aligned with the issues in this Hazard Mitigation Plan include the following:

Action Area 2: Improving Energy Performance in Existing Buildings

- Enable a rental energy disclosure requirement through the creation of a rental licensing program.
- Continue and expand thermal electrification programs (HeatSmart/CoolSmart).

Action Area 4. Rapid transition to electric vehicles

- **Develop electric vehicle charging infrastructure strategy.**

Action Area 5. Stormwater management

- Update stormwater management policies and develop design guidelines

- Investigate a stormwater enterprise fund to improve stormwater management

Action Area 6. Expanded tree canopy

- Formalize and implement a modern urban forestry management plan, including best practices and resilient species list
- Develop guidance and training for community stewardship of trees

Action Area 8. Healthy and resilient community

- Establish a preparedness education program and an emergency alert system that help protect the community from flooding and extreme heat events.

Action Area 9. Pathway to 100% renewable energy

- Extend the community choice electricity aggregation program and increase share of renewable energy

Action Area 10 Culture of climate action

- Organize community climate action and preparedness leadership program to educate the public and increase participation in climate programs.

Action Area 13. Regional Collaboration for coastal resilience

- Create a Mystic River Regional Coalition of neighboring municipalities to develop cohesive regional strategy and to push State action.
- Assess potential intervention options to address flood risk along Mystic River.

Since adopting the Climate Forward Plan in 2018, the City has issued two annual reports on progress in 2019 and 2020.

The 2019 Annual Report described the following progress on the above resilience action areas:

Stormwater management

• Engineering completed detailed citywide stormwater modeling and analysis, including an analysis of the impact of green stormwater infrastructure. The project was funded by a competitive state Municipal Vulnerability Preparedness Action Grant.

• Engineering drafted a stormwater runoff policy for driveways

• Staff conducted stakeholder interviews to understand barriers and opportunities to a developing a stormwater enterprise fund.

Expanded urban tree canopy

• The public tree inventory was completed in January 2019. The inventory will allow the City to better track the health and size of the public urban forest over time.

• A full draft of the Urban Forestry Management Plan was completed.

• The City Council approved a $120,000 Program Improvement Request for parks and tree maintenance.

• The newly formed Urban Forestry Committee began meeting and working on assisting with education and outreach about caring for urban trees.

• The City Council passed a Tree Preservation Ordinance that sets new requirements for tree removal on private property.

Healthy and resilient community

• New infographics with flood safety messages were developed and shared as part of Climate Preparedness Week. The infographics and additional information on flood preparedness will be shared on a new public webpage that will be released in 2020.

Regional collaboration for coastal resilience

• The Mystic River Watershed Association convened the **Resilient Mystic Collaborative** (RMC), which brings together communities to work on local solutions to increase climate resilience within the Mystic River watershed. The Collaborative has grown to include 17 of 21 watershed communities.

• The RMC successfully advocated the Massachusetts Department of Conservation and Recreation to prioritize improvements for Amelia Earhart Dam

The 2020 Annual Report described the following progress on the above resilience action areas:

STORMWATER MANAGEMENT

• The Engineering Department developed new Engineering Site Permit Rules and Regulations that apply to most construction projects. The rules and regulations complete the Climate Forward priority action to update stormwater management policies and to develop design guidelines.

• The Engineering Department has been working with a consultant to gather data and conduct analysis to develop an equitable stormwater enterprise fee system. This project was delayed due to the demands to respond to the coronavirus pandemic.

EXPANDED URBAN TREE CANOPY

• In June 2020, the Public Space and Urban Forestry Division published a draft of the Urban Forest Management Plan. This plan will serve as a guiding document for the expansion, preservation, and maintenance of Somerville's urban forest.

• The City planted 60 public trees during the Spring 2020 planting season and 140 public trees during the Fall 2020 planting season.

HEALTHY AND RESILIENT COMMUNITY

• The City launched a new Flood Ready website with information for the public about flood risk in Somerville and how to stay safe before, during, and after a major storm. Find out more at somervillema.gov/floodready

• In response to COVID safety protocols, the City updated heat safety information and created a new heat safety flyer in five languages. The information is available at somervillema.gov/keepcool

• Somerville was awarded a technical assistance grant from the Metropolitan Area Planning Council (MAPC) to work with their Public Health team on a project to improve heat health in Somerville. The project, Keep Cool Somerville, included extensive community engagement including convening an interdisciplinary advisory group, conducting interviews with stakeholders ranging from housing advocates to medical providers, sharing a community survey, and hosting two focus groups with older adults and youth. The project culminated in the creation of a Heat Health Strategy Toolkit.

• In November, Somerville was awarded a $52,250 Accelerating Climate Resilience Grant from MAPC to continue the Keep Cool Somerville project into 2021. The grant will support piloting community-driven heat resilience strategies and expanding community engagement.

REGIONAL COLLABORATION FOR COASTAL RESILIENCE

• Somerville has been leading a Municipal Vulnerability Preparedness (MVP) Program grant funded project with Boston, Chelsea, Everett, Revere, Winthrop, and the Mystic River Watershed Association (MyRWA) focused on regional infrastructure resilience. The project will identify vulnerabilities in regional infrastructure in the lower Mystic River basin and will prioritize improvements based on their impact on the lives of vulnerable populations. In October, the participating cities, project partners, and infrastructure owners and operators conducted a tabletop exercise that simulated a major winter storm. In 2021, the community-based organizations in the seven cities will collect data on how infrastructure disruptions affect residents' lives and routines.

• Somerville continues to be an active participant in the Resilient Mystic Collaborative, which focuses on building regional resilience to climate change within the Mystic River Watershed.

3. Urban Forestry Management Plan (Draft 2019)

This Urban Forest Management Plan considers the diversity, distribution, and general condition of the inventoried trees, and also provides a prioritized system for managing public trees. This comprehensive management plan that includes the following sections:

● **Section 1: The Importance of Trees in the City**
o *Section 1.1: Somerville's Tree Canopy* discusses the total community tree canopy and the benefits the canopy provides and compares these levels to other communities in the region.

o *Section 1.2: Ecosystem Services of Somerville's Street Trees* summarizes the economic, environmental, and social benefits that the City's street trees provide to the community. This section presents statistics of an I-Tree Streets benefits analysis conducted for Somerville.

● **Section 2: Somerville's Trees** summarizes the 2018 tree inventory data and presents trends, results, and observations.

● **Section 3: Expand, Preserve, and Maintain**
o *Section 3.1: Tree Planting Plan* provides a detailed statistical analysis of planting sites (including type, dimensions, and quantity). This section also includes a discussion on urban forest diversity issues, species selection, design methods, a detailed recommended species list, and recommendations for proper planting techniques and new tree maintenance tasks.

o *Section 3.2: Tree Maintenance Program* utilizes the inventory data to develop a prioritized maintenance schedule and projected budget for recommended tree maintenance over a seven-year period.

o *Section 3.3: Invasive Insect and Disease Management Strategy* summarizes potential threats to Somerville's tree population. Fundamentals of an Integrated Pest Management program are explained, as well as strategies that are being applied and/or should be applied to manage existing pest and disease issues.

o *Section 3.4: Storm Preparedness Plan* discusses policies and procedures to increase the efficiency and productivity of tree risk reduction and storm response operations.

● **Section 4: The Road Map**

o *Section 4.1: Operations Review* summarizes the existing conditions of urban forestry operations in the City, identifies gaps in the procedures, and suggests goals, guidelines, and specific improvements that, once adopted, will help standardize and optimize urban forestry program management and arboricultural practices.

o *Section 4.2: Funding Analysis* summarizes current funding level and sources, and compares these levels to the projected costs of completing tree planting, pruning and other maintenance, and removals at the suggested rate identified by the inventory and presented in Section 3.2.

o *Section 4.3: Ordinance/Policy Review* provides a review of Somerville's tree ordinance and recommendations for improving and building upon the ordinance and other primary policies, specifications, and other guidelines relating to public tree management

o *Section 4.4: Public Engagement* reviews current and potential partnerships for community engagement and resident involvement opportunities. Suggestions are provided for specific outreach projects, and basic public engagement tools and strategies.

4. Keep Cool Somerville

Keep Cool Somerville is an initiative to improve community resilience to heat. The initiative began in 2020 as a collaboration between the City of Somerville and the Metropolitan Area Planning Council (MAPC) to address the health impacts of climate change. The project team researched heat preparedness strategies and conducted a series of community engagement activities, which included stakeholder interviews, a photovoice project with resident participants, resident focus groups, and a public survey. The City and MAPC sought to understand Somerville residents' and organizations' perceptions of heat-related climate impacts, heat coping mechanisms, and interest in and capacity for heat health interventions. The project team used these engagement findings to inform the development of a toolkit of evidence-based and community-supported strategies for long-term summer heat preparedness, with a particular focus on populations most likely to be impacted by extreme heat. In 2021, the initiative built upon the findings of earlier community engagement and research to focus on supporting community solutions to address heat through the implementation of a Community Projects Grant Program. Community organizations and groups were invited to propose small-scale, pilot projects to improve resilience to heat and a handful of projects were funded and implemented over the summer. The Community Projects Grant Program had three goals:

- Build capacity for collaborative heat resilience planning and action among residents, community organizations, and City staff.
- Learn community concerns and preferred solutions for longer-term planning.
- Reduce heat health risk and discomfort for vulnerable Somerville residents during the summer of 2021. Six projects were chosen for mini grant funding and implementation in summer 2021:

Somerville Fresco! consists of a team of immigrant parents and grandparents who met regularly throughout the spring and summer to build their knowledge and advocacy skills to protect their neighbors and families from the health impacts of extreme heat.

Somerville Housing Authority (SHA) is piloting an Air Conditioner Lending Program that will conclude in the fall. As part of the project, SHA distributed and helped install 18 air conditioning units for families, older adults, and people with disabilities living in low-income housing.

Community Action Agency of Somerville (CAAS) distributed 17 air conditioning units and connected people to utility bill assistance and repayment plan programs to help them overcome cost barriers associated with home cooling.

Clarendon Hill Towers Resident Services Coordinators (RSC) distributed 150 fans via lottery to older adult households. The RSC decided to distribute fans to maximize the number of assisted households and to provide residents with a lower cost option to AC.

Bent/Haus Arts developed and hosted two free, outdoor, and interactive cooling art installations on the evenings of Friday, August 20th at South Street Farm and Sunday, August 29th at Chuckie Harris Park. The interactive artwork, Mistery Machine, incorporated music, cooling mist, and colorful animations that were refracted and reflected in the mist.

The Groundwork Somerville Green Team consists of local youth, ages 14-19. This summer, the Green Team focused on heat health issues. They developed and disseminated heat health education and outreach materials, including presentations, flyers, and short videos with testimonials from youth on their experiences with heat and ideas for actions to mitigate heat impacts.

For more details on these projects, refer to the Keep Cool Somerville report, prepared by MAPC for the City in September 2021.

5. Lower Mystic Regional Climate Assessment (Sept. 2021)

This project was carried out by the cities of Boston, Chelsea, Everett, Revere, Somerville, and Winthrop, which are members Resilient Mystic Collaborative. The Mystic River Watershed Association and several Community Based Organizations and consultants assisted with the project.

Based on the results of nearly a year of one-on-one meetings with infrastructure facility managers, state and federal emergency managers, and outside experts from other cities, the Lower Mystic Working Group pursued a three-part strategy to identify and prioritize critical climate resilient investments:

1. **Designed and held a functional exercise** with 13 critical infrastructure facilities to identify site-specific and cascading failures caused by a projected winter Nor'easter with a 1% annual chance of occurring in 2050. Under this type of scenario, coastal flooding would be expected to be 2.5 feet higher than today.

2. Took the results of the infrastructure exercise and combined them with other well-documented impacts on vulnerable populations that result from critical infrastructure disruptions in order to **develop an engagement strategy** designed to understand the lived experience of residents and workers expected to be most negatively affected by

damage to critical regional infrastructure.

3. **Analyzed the results of these two assessments together,** resulting in equity-informed findings and our recommendations for immediate and longer-term actions that will increase our resilience to these storms across the region.

The projects recommendations are summarized below.

1. Incorporate social resilience into vulnerability assessments and benefit-cost analyses.
2. Prioritize transportation corridors for essential workers during and immediately after extreme weather events.
3. **Develop and implement communications channels and strategies designed specifically to reach socially vulnerable populations in their first languages.**
4. Develop and implement communications channels and strategies designed specifically to reach socially vulnerable populations in their first languages.
5. **Prioritize making internet and cell phone communications infrastructure storm resilient.**
6. Decrease dependence on the power grid and generators.

For a full description of the methods, findings, and recommendations, refer to the Lower Mystic Regional Resilience Report.

SECTION 7: MITIGATION MEASURES FROM PREVIOUS PLAN

IMPLEMENTATION PROGRESS ON THE PREVIOUS PLAN

At a meeting of the Somerville Hazard Mitigation Team, City staff reviewed the mitigation measures identified in the 2016 Somerville Hazard Mitigation Plan and determined whether each measure had been completed, partially completed, revised, or not completed. Of those measures that had not been completed, the Team evaluated whether the measure should be deleted or carried forward into this Hazard Mitigation Plan 2022 Update. The decision on whether to delete or retain a particular measure was based on the team's assessment of the continued relevance or effectiveness of the measure. Table 38 summarizes the current status of mitigation measures from the 2016 plan.

Table 3: Status of Mitigation Measures from the 2016 Plan

Status of Recommended Mitigation Measures from the 2016 Plan			
Mitigation Measure	**Description**	**Current Status 2021** • **Completed** • **Partially Completed** • **Not Completed** • **Revise for 2021**	**Retain in 2022 Plan? (Revise?)**
FLOODNG HAZARDS			
A. *Inner Belt Industrial Park--Drainage Improvements*	The culvert and drainpipes in this area are silted up, resulting in reduced capacity. In addition, the drainpipe is undersized for current flows and has not been properly maintained. A comprehensive storm drainage system improvement is needed in this area. Improvements are being coordinated with the construction of the MBTA Green Line Extension which impacts this area.	**Partially complete** Green Line Extension will complete the project in 2022	YES

Status of Recommended Mitigation Measures from the 2016 Plan			
Mitigation Measure	**Description**	**Current Status 2021** • **Completed** • **Partially Completed** • **Not Completed** • **Revise for 2021**	**Retain in 2022 Plan? (Revise?)**
B. *Somerville Avenue—Drainage Improvements*	Flooding on Somerville Avenue can be significant and cause impacts to the road and the integrity of its base. This improvement would address the remaining flooding issues from Union Square to McGrath Highway with in-line storm drain improvements (replacement of existing pipes to increase capacity) between Union Square the Cambridge line.	**Completed**	NO
C. *Lincoln Park Combined Sewer Separation*	There are flooding and drainage issues in this area are due to combined sewers. A project to separate the combined sewers would alleviate flooding in this neighborhood.	**Not Completed** Studies pending, part of city-wide drainage plan	YES
D. *Tannery Brook drainage improvements*	There is flooding in this area is due to combined sewers. The City continues work to address and implement the drainage improvement strategy identified for this area, which includes increasing the capacity of the drainage pump that connects Tannery Brook Drain and the MWRA sewer on Alewife Brook Parkway.	**Not Completed** Studies pending, part of city-wide drainage plan	YES
E. *Medford Street Underpass* – New Pump	The City maintains pumps at this bridge; however, the pumps have failed in past resulting in the flooding and closure of the road. The installation of new pumps is planned as part of the MBTA Green Line Extension which will utilize the overpass.	**Partially Completed**	YES

Status of Recommended Mitigation Measures from the 2016 Plan			
Mitigation Measure	**Description**	**Current Status 2021** • **Completed** • **Partially Completed** • **Not Completed** • **Revise for 2021**	**Retain in 2022 Plan? (Revise?)**
F. *137 Washington St. Bridge* – New Pump	The railroad bridge at 137 Washington Street floods during large rain events and due to older pumps which do not function well. The MBTA has plans for a new bridge, including new automatic pumps, which will be part of the MBTA Green Line	**Completed** Green Line Extension replacing bridge, open in 6 months	NO
G. *Route 28 N Underpass drainage improvements*	*Route 28 N Underpass* ***drainage improvements***- The underpass is served by gates and pumps owned and operated by DCR as well as a combined sewer overflow station owned by the MWRA. The gates are prone to jamming and which leads to flooding of the underpass. The City has expressed a desire to obtain warning devices that could alert motorists to flooded underpasses and is interested in upgrades to the gates and pumps to reduce the risk of flooding.	**Not Completed**	YES
H. *Commuter Rail Line drainage improvements*	The City will continue to work with the MBTA to remediate flooding along the commuter rail line right-of-way through drainage system improvements.	**Not Completed** Split into 2 projects for **Fitchburg line and Lowell line** (most of Lowell line issues resolved by GLX)	YES
I. *Cedar Street and Hall Street relief drain*	The City proposes the construction of a relief drain o reduce street flooding in this area, which is a major access route for emergency vehicles.	**Completed**	NO

Status of Recommended Mitigation Measures from the 2016 Plan			
Mitigation Measure	**Description**	**Current Status 2021** • **Completed** • **Partially Completed** • **Not Completed** • **Revise for 2021**	**Retain in 2022 Plan? (Revise?)**
J. *Somerville Bike Path—Drainage Improvements*	During the original construction of the path, a drainage system was not included. To address the flooding in this low-lying area, the City would like to install dry wells and reconstruct the path.	**Completed**	NO
K. *Elevate Emergency Generators in Public Safety Building*	As the City plans to keep this building in use for municipal purposes, there is a desire to elevate the emergency generators that serve the building. As a building that has been flooded in the past, elevation of the generators would allow the building to continue to operate in the event of flooding or loss of power.	**REVISE** Build new Public Safety facility (move to Multi-Hazard category); the old building will be sold to a developer.	YES (Revise)
L. *Green Infrastructure Measures*	The City continues to be interested in opportunities to reduce stormwater runoff and improve water quality through use of drainage natural systems. This would include reduction of impervious surfaces that encourage runoff as well as installation of landscaped and vegetated spaces to retain and infiltrate stormwater.	**Partially complete** **REVISE** Somerville Ave done. Plans for: Spring Hill, Highland Ave, and Union Square	YES (Revise)

Status of Recommended Mitigation Measures from the 2016 Plan			
Mitigation Measure	**Description**	**Current Status 2021** • **Completed** • **Partially Completed** • **Not Completed** • **Revise for 2021**	**Retain in 2022 Plan? (Revise?)**
M. *Floodplain Management*	Continue to enforce the Floodplain Zoning District (Section 470) and associated building regulations for floodplain areas. Update this district to remain consistent with FEMA guidelines and floodplain mapping.	**Partially completed** Floodplain maps were carried over to 2019 Zoning overhaul; need to update when the next FEMA maps are finalized **REVISE** Add: Develop a system to measure implementation of Green Infrastructure	YES (Revise)
N. *Floodplain Mapping*	Maintain up to date maps of local FEMA identified floodplains.	**Combine with #M above**	NO

Status of Recommended Mitigation Measures from the 2016 Plan			
Mitigation Measure	**Description**	**Current Status 2021** • **Completed** • **Partially Completed** • **Not Completed** • **Revise for 2021**	**Retain in 2022 Plan? (Revise?)**
WINTER STORM HAZARDS			
O. *Underground Utilities*	Snow loading on trees has led to falling branches and the downing of electrical and other overhead utility lines. The City continues to pursue its plan, where possible, to place overhead utilities underground. The current focus for this effort is Beacon Street.	**Not completed/REVISE** Installation on Beacon St did not succeed. Retrofitting existing streets not economically feasible. **REVISE:** consider if building new streets; install stronger utility poles; install alternate circuits in vulnerable areas; provide oversight and planning when breaking ground to capitalize on the opportunity to upgrade or change systems to advance long-range goals.	YES (Revise)
P. *Develop a Snow Disposal Plan*	With the development of Assembly Square, the city is losing a snow dump location. The City looks to develop a snow disposal plan to address where snow will be placed after removal from city streets.	**Not a Mitigation Measure** (Response/recovery)	NO

Status of Recommended Mitigation Measures from the 2016 Plan			
Mitigation Measure	**Description**	**Current Status 2021** • **Completed** • **Partially Completed** • **Not Completed** • **Revise for 2021**	**Retain in 2022 Plan? (Revise?)**
Q. *Purchase a Snow Melter*	To address the need to dispose of snow resulting from large winter storm events, the City would like to purchase a snow melter that would liquefy the snow and allow for it to drain into the storm sewer system. The City has a snow melter, but it is only minimally effective due to small capacity	**Not a Mitigation Measure** (Response/recovery)	NO
GEOLOGIC HAZARDS			
R. *Seismic upgrades to the communications center*	The Public Safety building should be reviewed to determine if changes are need in order to be brought up to seismic standards. This review would help determine and address the potential for a collapse of the communications system.	**REVISE** Build new Public Safety Building (move to Multi-Hazard category)	YES (Revise)
MULTI-HAZARDS			
S. *Develop Unified/Centralized Communications System*	City departments that address and respond to natural hazard events are currently on separate communication systems. It is proposed that the city develop a unified communication system for public safety officials and emergency responders to facilitate more centralized and efficient communications.	**REVISE** Create a resilient communications system; City planning a 2-phase upgrade; to require Bi-Directional Amplifiers (BDA) in high rise buildings	YES (Revise)

As indicated in Table 38, Somerville made progress implementing several mitigation measures identified in the 2016 Hazard Mitigation Plan. The Somerville Avenue drainage improvements, 137 Washington Street bridge, Cedar Street and Hall Street relief drain, and Somerville Bike Path drainage improvements have been completed. Projects partially completed include the Inner Belt Industrial Park drainage improvements, the Medford Street underpass, and Green Infrastructure implementation.

The projects that were partially completed and most of those that were not completed since 2016 will be carried over into the 2022 updated plan. Of the 19 mitigation measures in the 2016 plan, six will be carried over into this 2021plan update, and six others will be carried over with revisions.

Moving forward into the next five-year plan implementation period there will be many more opportunities to incorporate hazard mitigation into the City's decision-making processes. The challenges the city faces in implementing these measures are primarily due to limited funding and available staff time. This plan should help the city prioritize the best use of its limited resources for enhanced mitigation of natural hazards

SECTION 8: HAZARD MITIGATION STRATEGY

WHAT IS HAZARD MITIGATION?

Hazard mitigation means to permanently reduce or alleviate the losses of life, injuries and property resulting from natural hazards through long-term strategies. These long-term strategies include planning, policy changes, education programs, infrastructure projects and other activities. FEMA currently has three mitigation grant programs: the Hazards Mitigation Grant Program (HMGP), the Building Resilient Infrastructure and Communities (BRIC) grant program, and the Flood Mitigation Assistance (FMA) program. The three links below provide additional information on these programs.

https://www.fema.gov/hazard-mitigation-grant-program
https://www.fema.gov/bric
https://www.fema.gov/flood-mitigation-assistance-grant-program

Hazard Mitigation Measures can generally be sorted into the following groups:

- Prevention: Government administrative or regulatory actions or processes that influence the way land and buildings are developed and built. These actions also include public activities to reduce hazard losses. Examples include planning and zoning, building codes, capital improvement programs, open space preservation, and stormwater management regulations.
- Property Protection: Actions that involve the modification of existing buildings or infrastructure to protect them from a hazard or removal from the hazard area. Examples include acquisition, elevation, relocation, structural retrofits, flood proofing, storm shutters, and shatter resistant glass.
- Public Education & Awareness: Actions to inform and educate citizens, elected officials, and property owners about the potential risks from hazards and potential ways to mitigate them. Such actions include outreach projects, real estate disclosure, hazard information centers, and school-age and adult education programs.
- Natural Resource Protection: Actions that, in addition to minimizing hazard losses also preserve or restore the functions of natural systems. These actions include sediment and erosion control, stream corridor restoration, watershed management, forest and vegetation management, and wetland restoration and preservation.
- Structural Projects: Actions that involve the construction of structures to reduce the impact of a hazard. Such structures include storm water controls (e.g., culverts), floodwalls, seawalls, retaining walls, and safe rooms.
- Emergency Services Protection: Actions that will protect emergency services before, during, and immediately after an occurrence. Examples of these actions include protection of warning system capability, protection of critical facilities, and protection of emergency response infrastructure.
  (Source: FEMA Local Multi-Hazard Mitigation Planning Guidance)

NEW DEVELOPMENT AND INFRASTRUCTURE

As part of the process of developing recommendations for new mitigation measures for this plan update, the City considered the issues related to new development, redevelopment, and infrastructure needs in order reduce and limit future risks of natural hazards. Taking into consideration a host of measures to regulate new development and mitigate its impacts, including the city's Floodplain Overlay Zoning District enforced for new development, the stormwater management requirements enforced for new development by the Department of Public Works, the Building Code enforced for new development by the Inspectional Services Division, the Wetlands Protection Act enforced for new development by the Conservation Commission, the city's Comprehensive Plan, *SomerVision,* Somerville Climate Forward Plan and Climate Change Vulnerability Assessment, the Lower Mystic Regional Climate Assessment, the Urban Forestry Plan, the Keep Cool Somerville initiative, and the Open Space and Recreation Plan, the City has determined that existing policies, planning, and regulatory measures are taking full advantage of local Home Rule land use regulatory authority to minimize natural hazard impacts of new development and redevelopment. As a mature city with older infrastructure, the major priorities that emerged for the City are strategic infrastructure upgrades in the most problematic areas. These upgrades will provide greater capacity to reduce hazard risks for both existing and new development as well as redevelopment in the City. This is the focus of several of this plan's recommended mitigation measures in the following section.

RECOMMENDED MITIGATION MEASURES

The recommended mitigation measures for this plan update are listed below and summarized in Table 39 (prioritization) and Table 40 (lead agencies, cost estimates, timelines, funding sources).

Of the 37 mitigation measures listed, six of the drainage improvement projects were carried over from the previous 2016 Hazard Mitigation Plan, keeping the same priorities (one high priority and the other five medium priority). Six other mitigation measures were carried over but revised from the 2016 plan, five of which were assigned different priorities for the 2022 plan: Green Infrastructure, Floodplain Management, Underground/hardened utilities, upgraded communications system, and the Public Safety facility were all increased to high priority. In addition, there are 25 completely new mitigation measures for this 2022 plan update.

The mitigation measures are grouped by their hazard categories, with several of them in a "multi-hazard" category.

Flood Hazard Mitigation Measures

A) *Inner Belt Industrial Park drainage improvements* - The culvert and drainpipes in this area are silted up, resulting in reduced capacity. In addition, the drainpipe is undersized for current flows and has not been properly maintained. A comprehensive storm drainage

system improvement is needed in this area. Improvements are being coordinated with the construction of the MBTA Green Line Extension which impacts this area. This project is partially completed as of 2021.

B) *Lincoln Park sewer separation* – There are flooding and drainage issues in this area are due to combined sewers. A project to separate the combined sewers would alleviate flooding in this neighborhood. This issue will be addressed by a city-wide drainage master plan, which will propose specific solutions for this and other problems areas.

C) *Tannery Brook drainage improvements* – There is flooding in this area is due to combined sewers. The City continues work to address and implement the drainage improvement strategy identified for this area. This issue will be addressed by a city-wide drainage master plan, which will propose specific solutions for this and other problems areas.

D) *Medford Street Underpass pumps*- The City maintains pumps at this bridge; however, the pumps have failed in past resulting in the flooding and closure of the road.

E) *Route 28 N Underpass drainage improvements*- The underpass is served by gates and pumps owned and operated by DCR as well as a combined sewer overflow station owned by the MWRA. The gates are prone to jamming and which leads to flooding of the underpass. The City has expressed an interest in installing warning devices that could alert motorists to flooded underpasses and is interested in upgrades to the gates and pumps to reduce the risk of flooding.

F) *Commuter Rail Line drainage improvements* – The City continues to coordinate with the MBTA to remediate flooding along the commuter rail line right-of-way through drainage system improvements. There are two commuter rail rights-of-way in Somerville, and for the 2022 plan update these are split into two; (F.1) Fitchburg Line and (F.2) Lowell line. Drainage work on the Lowell line has been done by the GLX project, and most of the problems at this site has been resolved. Further work is still needed on the Lowell line.

G) *Green Infrastructure Measures* – The City continues to be interested in opportunities to reduce stormwater runoff and improve water quality through use of drainage natural systems. This includes reduction of impervious surfaces that encourage runoff as well as installation of landscaped and vegetated spaces to retain and infiltrate stormwater. Install right-of-way bioswales and distributed soft infrastructure systems to reduce inflow to drainage systems Since the 2016 plan the City has installed Green Infrastructure along Somerville Avenue, and plans additional installations on Highland Avenue, in Union Square Plaza, and the Spring Hill sewer separation project.

H) *Floodplain Management*: Continue to enforce the Floodplain Zoning District (Section 470) and associated building regulations for floodplain areas. Update the floodplain district map to remain consistent with FEMA guidelines and pending new floodplain mapping. The

City's Zoning Code was revised in 2016, and rules regulating stormwater runoff were adopted. Establish a process to document flooding impacts and quantify damages to track patterns of flooding impacts and support benefit/cost analyses for mitigation projects.

I) *Upgrade Poplar Street Pump Station, which handles stormwater from Union Square.*

The facility will be comprised of a 50 million-gallons-per-day (MGD) pump array, a 4.0 MG storage tank, a Stormwater Emergency Management Center, catch-basin grit handling area, and garage bay for Sewer Department fleet management. The project will fundamentally change the way the City of Somerville manages much of its drainage system. The City's current stormwater system allows stormwater to combine with sewage through shared pipes, which in large storm events can lead to sometimes catastrophic flooding in Union Square and surrounding areas. The project will allow the City to discharge up to 50-million gallons per day of stormwater from the Poplar Street Pump Station to the MBTA drainage system. Sewage will proceed separately to the Deer Island facility. The project will increase the resiliency of residential and business communities throughout eastern Somerville.

J) *Complete Sewer Separation for Spring Hill (feeds stormwater to Poplar St Pump Station).*

K) *Complete drainage & pump station upgrades for Boynton Yards.*

L) *Implement the Nunziato Field Stormwater Storage Project, a 1.2 MG tank for stormwater flowing toward Union Square.*

M) *Complete the Somerville Avenue Sewer Separation and Streetscapes Restoration project.*

N) *Prepare a City-Wide Drainage and Stormwater Study; identify solutions for problem drainage areas.*

O) *Consider participating in FEMA's Community Rating System (CRS) to provide reduced insurance premiums.*

P) *Enhance public communication on flood hazard mitigation techniques; facilitate 2-way communication to provide public information and solicit public input.*

Q) *Continue ongoing stormwater modeling to understand the capacity of the drainage system to accommodate the projected increase in rainfall as a result of climate change.*

R) *Consider adopting flood management overlays for Assembly Square, Union Square, Davis Square and other commercial districts to require property owners to manage stormwater onsite.*

S) *The City should consider adopting a stormwater enterprise fund to provide dedicated funding to improve stormwater management.*

T) *Transportation system resilience: the City can improve resilience through increased tree canopies and flood storage systems. The City should also take an advocacy role with MBTA and MassDOT to protect the highway and transit networks from climate change.*

Coastal Flooding/Sea Level Rise Mitigation Measures

U) *Amelia Earhart Dam--Work with state and regional partners to address flanking of the dam by increased storm surges and Sea Level Rise due to climate change*

V) *Shraft's Center flood pathway--The City should advocate to ensure that the flooding solutions are implemented, and that jointly occurring rainfall and coastal storms are addressed*

Winter Storm Hazard Mitigation Measures

W) *Strengthen and harden overhead transmission; Install stronger poles; traffic lights on poles/mast arms; consider installing underground utilities when building new streets where feasible.*

X) Promote solar and backup battery storage; install alternate circuits in vulnerable areas; integrate with a Distributed Energy Network.

Geologic Hazard Mitigation Measures

Y) *Conduct a seismic assessment of city buildings with NE States Emergency Consortium.*

Multi-Hazard Mitigation Measures

Z) Construct a new Public Safety Building with increased resilience to flooding and earthquakes.

AA) Develop a resilient Communications System; install Bi-Directional Amplifies in high-rise buildings

BB) Prepare an Asset Management Database of municipal facilities to prioritize replacement of facilities based on the likelihood and consequences of failure

Extreme Heat Mitigation Measures

CC) Conduct Sanitary Code enforcement, rental inspections to address functioning windows, mold, air conditioning

DD) Enhance the ability for city facilities and other community organizations to serve as resilient cooling/warming centers with provisions for backup power and hardening against natural hazards; provide diverse activities for residents at cooling centers

EE) The City should promote solar, heat pumps, and battery backup in new developments.

FF) Develop a resilient notification and public information system in multiple languages that works despite natural hazards impacts in Somerville.

GG) Increase tree planting city-wide; implement the Urban Forestry Plan.

HH) The City should adopt policies that require or incentivize the use of lighter-colored building materials, green roofs, the dedication of part of a development area as open space, and planting street trees.

Drought Hazard Mitigation Measures

II) Provide landscaping guidance for use of native plant species and drought-tolerant plants.

JJ) The City should require enhanced water conservation measures in drought emergencies, such as:

- Develop an ordinance to restrict the use of public water resources for non-essential usage, such as landscaping, washing cars, filling pools etc.
- Adopt an ordinance to prioritize or control water use, particularly for emergency situations like firefighting.

KK) The City should encourage citizens through public outreach to use water-saving measures, such as:

- Installing low-flow showerheads and toilets
- Adjusting sprinklers to water the lawn and not the sidewalk or street.
- Running dishwashers and washing machines only when they are full.
- Checking for leaks in plumping or faucets.
- Installing rain-capturing devices for irrigation.
- Encouraging the installation of graywater systems in homes to encourage water reuse.

PROCESS FOR SETTING PRIORITIES FOR MITIGATION MEASURES

The last step in developing the City's mitigation strategy is to assign a level of priority to each mitigation measure so as to guide the focus of the City's limited resources towards those actions with the greatest potential benefit. At this stage in the process, the Local Hazard Mitigation Planning Team had limited access to detailed analyses of the cost and benefits of any given mitigation measure, so prioritization is based on the local team members' understanding of existing and potential hazard impacts and an approximate sense of the costs associated with pursuing any given mitigation measure.

Priority setting was based on local knowledge of the hazard areas, including impacts of hazard events, the extent of the area impacted, and the relation of a given mitigation measure to the City's goals. Other factors considered included the number of homes and businesses affected, whether or not road closures occurred and what impact closures had on delivery of emergency services and the local economy, anticipated project costs, whether any environmental constraints existed, and whether the estimated costs could be justified relative to the anticipated benefits.

Table 39 below demonstrates the prioritization of the City's potential hazard mitigation measures. For each mitigation measure, the geographic extent of the potential benefiting area is identified as is an estimate of the overall benefit and cost of the measures. The benefits, costs, and overall priority were evaluated in terms of:

Estimated Benefits	
High	Action will result in a significant reduction of hazard risk to people and/or property from a hazard event
Medium	Action will likely result in a moderate reduction of hazard risk to people and/or property from a hazard event
Low	Action will result in a low reduction of hazard risk to people and/or property from a hazard event
Estimated Costs	
High	Estimated costs greater than $250,000
Medium	Estimated costs between $100,000 to $250,000
Low	Estimated costs less than $100,000 and/or staff time
Mitigation Priority	
High	Action very likely to have political and public support and necessary maintenance can occur following the project, and the costs seem reasonable considering likely benefits from the measure
Medium	Action may have political and public support and necessary maintenance has potential to occur following the project
Low	Not clear if action has political and public support and not certain that necessary maintenance can occur following the project

Table 39: Prioritization of Mitigation Measures				
Somerville Mitigation Recommendations				
Mitigation Measure	**Geographic area covered**	**Benefit Estimate**	**Cost Estimate**	**Priority**
FLOOD HAZARDS				
A) Inner Belt Industrial Park--Drainage Improvements	Inner Belt Industrial Park	High	High	High
B) Lincoln Park Combined Sewer Separation	Lincoln Park area	Medium	High	Medium
C) *Tannery Brook—Drainage Improvements*	Tannery Brook are	Medium	High	Medium
D) Medford Street Underpass – New Pump	Medford Street underpass	Medium	Medium	Medium
E) Route 28 N Underpass Installation of Warning Device	Route 28 N	Medium	Medium	Medium
F.1) Complete drainage upgrade for Fitchburg Commuter Rail Line	Fitchburg Commuter Rail underpass	Medium	High	Medium
F.2) Complete drainage upgrades for Lowell Commuter Rail Line	Lowell Commuter Rail underpass	Medium	High	Medium
G) Promote Green Infrastructure (GI) on public facilities and private developments. Implement GI at Spring Hill, Highland Ave, and Union Square. Install right-of-way bioswales and distributed soft infrastructure systems to reduce inflow to drainage systems	City-wide	Medium	Med-High	High
H) Floodplain Management and mapping; establish a process to document flooding impacts and quantify damages to support benefit/cost analyses	City-wide	Medium	Low	High
I) Upgrade Poplar Street Pump Station, handles stormwater from Union Square	Poplar Street, affects Union Square area	High	High	High
J) Complete Sewer Separation for Spring Hill (feeds stormwater to Poplar St Pump Station)	Spring Hill	High	High	High
K) Complete drainage & pump station upgrades for Boynton Yards	Boynton Yards, key development area	High	High	High

Table 39: Prioritization of Mitigation Measures				
Somerville Mitigation Recommendations				
Mitigation Measure	**Geographic area covered**	**Benefit Estimate**	**Cost Estimate**	**Priority**
L) Implement the Nunziato Field Stormwater Storage Project, a 1.2 MG tank for stormwater flowing toward Union Square	Nunziato Field, affects Union Square	High	High	High
M) Complete the Somerville Avenue Sewer Separation and Streetscapes Restoration project	Somerville Avenue	High	High	High
N) Prepare a City-Wide Flood Management Study; identify solutions for problem drainage areas	City-wide	High	Medium	High
O) Consider participating in FEMA's Community Rating System (CRS) to provide reduced insurance premiums	Flood insurance policies City-wide	Medium	Low	Medium
P) Enhance public communication on flood hazard mitigation techniques; facilitate 2-way communication to provide public information and solicit public input	City-wide	Medium	Low	High
Q) Conduct detailed modeling to understand the capacity of the drainage system to accommodate the projected increase in rainfall as a result of climate change	City-wide	Medium	Medium	High
R) Consider adopting flood management overlays for Assembly Square, Union Square and Davis Square to require property owners to manage stormwater onsite	Assembly Square, Union Square and Davis Square--key commercial districts	Medium	Low	Medium
S) The City should consider adopting a stormwater enterprise fund to provide dedicated funding to improve stormwater management	City-wide	Medium	Low	Medium
T) Transportation system resilience: the City can improve resilience through increased tree canopies and flood storage systems. The City should also take an advocacy role with MBTA and MassDOT to protect the highway and transit networks from climate change.	Critical transportation corridors city-wide	High	Medium	High
U) Amelia Earhart Dam Work with state and regional partners to address flanking of the dam by increased storm surges and Sea Level Rise due to climate change	Amelia Earhart Dam, affects East Somerville	High	Low	High

Table 39: Prioritization of Mitigation Measures				
Somerville Mitigation Recommendations				
Mitigation Measure	**Geographic area covered**	**Benefit Estimate**	**Cost Estimate**	**Priority**
V) *Shraft Center flood pathway: the City should advocate to ensure that the flooding solutions are implemented, and that jointly occurring rainfall and coastal storms are addressed*	Shraft's Center, Affects East Somerville	High	Low	High
WIND AND WINTER HAZARDS				
W) *Strengthen and harden overhead transmission; Install stronger poles; traffic lights on poles/mast arms; install underground utilities when building new . Provide oversight and planning when breaking ground to capitalize on the opportunity to upgrade or change systems to advance long-range goal*	City-wide	High	High	Medium
X) Promote solar and backup battery storage; install alternate circuits in vulnerable areas; integrate with a Distributed Energy Network	City-wide	Medium	High	High
GEOLOGIC HAZARDS				
Y) *Conduct a seismic assessment of city buildings with NE States Emergency Consortium*	Municipal buildings city-wide	Low	Low	Low
MULITI-HAZARDS				
Z) *Construct a new Public Safety Building with increased resilience to flooding and earthquakes*	Public Safety Building (serves City-wide)	High	High	High
AA) Develop a resilient Communications System; install Bi-Directional Amplifies in high-rise buildings	City-wide	High	High	High
BB) Prepare an Asset Management Database of municipal facilities to prioritize replacement of facilities based on the likelihood and consequences of failure	City-wide	Medium	Low	Medium
EXTREME HEAT HAZARDS				
CC) *Conduct Sanitary Code enforcement, rental inspections to address functioning windows, mold, air conditioning*	City-wide	Medium	Low	Medium

Table 39: Prioritization of Mitigation Measures				
Somerville Mitigation Recommendations				
Mitigation Measure	**Geographic area covered**	**Benefit Estimate**	**Cost Estimate**	**Priority**
DD) Enhance the ability for city facilities and other community organizations to serve as resilient cooling/warming centers with provisions for backup power and hardening against natural hazards; provide diverse activities for residents at cooling centers	City-wide	Medium	High	High
EE) The City should promote Solar, Heat Pumps, battery backup in new development	City-wide	Medium	Low	Medium
FF) *Develop a resilient notification and public information system in multiple languages that works despite natural hazards impacts in Somerville.*	City-wide	High	Low	High
GG) Increase tree planting city-wide; implement the Urban Forestry Plan	City-wide	High	High	High
HH) b The City should adopt policies that require or incentivize the use of lighter-colored building materials, green roofs, the dedication of part of a development area as open space, and planting street trees.	City-wide	Medium	Low	Medium
DROUGHT HAZARDS				
II) Provide landscaping guidance for use of native plant species and drought-tolerant plants	City-wide	b	Low	Low
JJ) The City should require enhanced water conservation measures in drought emergencies	City-wide	Medium	Low	Medium
KK) The City should encourage citizens through public outreach to use water-saving measures.	City-wide	Medium	Low	Medium

DESCRIPTION OF RECOMMENDED MITIGATION MEASURES

This plan's recommended mitigation measures are shown in Table 40, along with the following attributes for each recommended measure:

Description of the Mitigation Measure – The description of each mitigation measure is brief and cost information is given only if cost data were already available from the community. The cost data represent a point in time and would need to be adjusted for inflation and for any changes or refinements in the design of a particular mitigation measure.

Priority – As described above and summarized in Table 39, the designation of high, medium, or low priority was done considering estimated potential benefits and estimated project costs, as well as other factors discussed by the local team in some cases.

Implementation Responsibility – The designation of implementation responsibility was done based on a general knowledge of what each municipal department is responsible for. It is likely that most mitigation measures will require that several departments work together and assigning staff is the sole responsibility of the governing body of each community.

Time Frame – The time frame is based on the complexity of the measure and whether it is conceptual, in design, or already designed. Because the time frame for this plan is five years, the timing for mitigation measures is within this framework. The identification of a likely time frame is not meant to constrain a community from taking advantage of funding opportunities as they arise.

Potential Funding Sources – This column identifies the most likely sources of funding for each measure. This information is preliminary and may vary depending on a number of factors. These factors include whether or not a mitigation measure has been studied, evaluated, or designed, or if it is still in the conceptual stages. Each grant program has specific eligibility requirements. Identification of a potential funding source does not guarantee that a project will be eligible for funding. Upon adoption of this plan, the local team should explore funding sources in more detail.

Additional information on funding sources – The best way to determine eligibility for a particular funding source is to review the project with a staff person at the funding agency. The following websites provide an overview of programs and funding sources.

> Army Corps of Engineers (ACOE) – The website for the North Atlantic district office is http://www.nae.usace.army.mil/. The ACOE provides assistance in a number of types of projects including flood damage reduction and flood plain management services.
>
> Massachusetts Emergency Management Agency (MEMA) – The grants page https://www.mass.gov/hazard-mitigation-assistance-grant-programs describes the various Hazard Mitigation Assistance Program.

Table 40: Recommended Mitigation Measures					
Somerville Mitigation Recommendations					
Mitigation Action	**Lead Agency**	**Priority**	**Estimated Timeframe 2022-26**	**Estimated Cost**	**Potential Funding Sources**
FLOOD HAZARDS					
A) *Inner Belt Industrial Park-- Drainage Improvements*	MBTA / City of Somerville	High	2022-23	>$250,000	MassDOT/MBTA
B) *Lincoln Park Combined Sewer Separation*	DPW/ Engineering	Medium	2022-25	>$250,000	City of Somerville
C) *Tannery Brook—Drainage Improvements*	DPW/ Engineering	Medium	2022-25	>$250,000	MassDOT/City of Somerville
D) *Medford Street Underpass – New Pump*	MBTA / City of Somerville	Medium	2022-24	$100,000 - $250,000	MassDOT/MBTA
E) *Route 28 N Underpass Installation of Warning Device*	MassDOT/ City of Somerville	Medium	2022-24	$100,000 - $250,000	MassDOT
F.1) *Complete drainage upgrade for Fitchburg Commuter Rail Line*	MBTA / City of Somerville	Medium	2022-24	>$250,000	MassDOT/MBTA
F.2) *Complete drainage upgrades for Lowell Commuter Rail Line*	MBTA / City of Somerville	Medium	2022	>$250,000	MassDOT/MBTA
G) *Promote Green Infrastructure (GI) on public facilities and private developments. Implement GI at Spring Hill, Highland Ave, and Union Square. Install right-of-way bioswales and distributed soft*	Engineering/DPW/ Conservation Commission	Medium	2022-26	>$250,000	Private Developers, EPA, City of Somerville

Table 40: Recommended Mitigation Measures					
Somerville Mitigation Recommendations					
Mitigation Action	**Lead Agency**	**Priority**	**Estimated Timeframe 2022-26**	**Estimated Cost**	**Potential Funding Sources**
infrastructure systems to reduce inflow to drainage systems					
H) Floodplain Management and mapping; establish a process to document flooding impacts and quantify damages to support benefit/cost analyses	Office of Strategic Plan. & Comm. Dev. /Conservation Commission / Emergency Management Director/Engineering/ Office of Sustainability and Environment	High	2022-26	<$100,000 /Staff time	City of Somerville
I) Upgrade Poplar Street Pump Station, handles stormwater from Union Square	DPW/ Engineering	High	2022-25	>$250,000	City of Somerville /SRF/FEMA
J) Complete Sewer Separation for Spring Hill (feeds stormwater to Poplar St Pump Station)	DPW/ Engineering	High	2022-25	>$250,000	City of Somerville /SRF
K) Complete drainage & pump station upgrades for Boynton Yards	DPW/ Engineering	High	2023-26	>$250,000	City of Somerville /SRF
L) Implement the Nunziato Field Stormwater Storage Project, a 1.2 MG tank for stormwater flowing toward Union Square	DPW/ Engineering	High	2024-26	>$250,000	City of Somerville /SRF
M) Complete the Somerville Avenue Sewer Separation and	DPW/ Engineering	High	2023-26	>$250,000	City of Somerville

Table 40: Recommended Mitigation Measures					
Somerville Mitigation Recommendations					
Mitigation Action	**Lead Agency**	**Priority**	**Estimated Timeframe 2022-26**	**Estimated Cost**	**Potential Funding Sources**
Streetscapes Restoration project					/SRF
N) *Prepare a City-Wide Flood Management Study; identify solutions for problem drainage areas*	DPW/ Engineering	Medium	2022-23	$100,000 - $250,000	City of Somerville
O) *Consider participating in FEMA's Community Rating System (CRS) to provide reduced insurance premiums*	Emergency Mangt/ Office of Strategic Plan. & Comm Dev.	Medium	2022-24	<$100,000 /Staff time	City of Somerville /FEMA
P) *Enhance public communication on flood hazard mitigation techniques; facilitate 2-way communication to provide public information and solicit public input*	Emergency Management / Communications Department / Office of Sustainability and Environment	High	2022-24	<$100,000 /Staff time	City of Somerville /MVP Grant
Q) *Conduct detailed modeling to understand the capacity of the drainage system to accommodate the projected increase in rainfall as a result of climate change*	DPW/ Engineering / Office of Sustainability and Environment	High	2023-26	$100,000 - $250,000	City of Somerville
R) *Consider adopting flood management overlays for Assembly Square, Union Square and Davis Square to require property owners to manage stormwater onsite*	Office of Sustainability and Environment/Office of Strategic Planning & Comm. Development /	Medium	2022-24	<$100,000 /Staff time	City of Somerville

Table 40: Recommended Mitigation Measures					
Somerville Mitigation Recommendations					
Mitigation Action	**Lead Agency**	**Priority**	**Estimated Timeframe 2022-26**	**Estimated Cost**	**Potential Funding Sources**
	Engineering				
S) *The City should consider adopting a stormwater enterprise fund to provide dedicated funding to improve stormwater management*	DPW / Office of Strategic Planning & Comm. Develop. / Office of Sustainability and Environment / Engineering	Medium	2022-24	<$100,000 /Staff time	City of Somerville /MVP Grants
T) *Transportation system resilience: the City can improve resilience through increased tree canopies and flood storage systems. The City should also take an advocacy role with MBTA and MassDOT to protect the highway and transit networks from climate change.*	Office of Sustainability and Environment / OSPCD-Mobility Division / Highways	High	2022-26	$100,000 - $250,000	City of Somerville
COASTAL FLOODING / SEA LEVEL RISE					
U) *Amelia Earhart Dam: Work with state and regional partners to address flanking of the dam by increased storm surges and Sea Level Rise due to climate change*	Office of Sustainability and Environment	High	2022-26	<$100,000 /Staff time	City of Somerville; Other outside funding TBD
V) *Shraft's Center flood pathway: the City should advocate to ensure that the flooding*	Engineering; Office of Sustainability and	High	2022-26	<$100,000 /Staff time	City of Somerville

Table 40: Recommended Mitigation Measures					
Somerville Mitigation Recommendations					
Mitigation Action	**Lead Agency**	**Priority**	**Estimated Timeframe 2022-26**	**Estimated Cost**	**Potential Funding Sources**
solutions are implemented, and that jointly occurring rainfall and coastal storms are addressed	Environment				
WIND AND WINTER HAZARDS					
W) *Strengthen and harden overhead transmission; Install stronger poles; traffic lights on poles/mast arms; install underground utilities when building new streets. Provide oversight and planning when breaking ground to capitalize on the opportunity to upgrade or change systems to advance long-range goal*	DPW/Engineering/ Utilities / Office of Sustainability and Environment	Medium	2022-26	>$250,000	Utilities / City of Somerville/ MassDOT
X) Promote solar and backup battery storage; install alternate circuits in vulnerable areas; integrate with a Distributed Energy Network	Office of Sustainability and Environment / Office of Strategic Planning & Comm. Development	High	2022-26	>$250,000	Private property developers
GEOLOGIC HAZARDS					
Y) *Conduct a seismic assessment of city buildings with NE States Emergency Consortium*	Building Department/ Engineering	Low	2023-25	<$100,000 /Staff time	City of Somerville

Table 40: Recommended Mitigation Measures					
Somerville Mitigation Recommendations					
Mitigation Action	**Lead Agency**	**Priority**	**Estimated Timeframe 2022-26**	**Estimated Cost**	**Potential Funding Sources**
MULITI-HAZARDS					
Z) Construct a new Public Safety Building with increased resilience to flooding and earthquakes	Capital Projects Dept/ Engineering/Police Dept./Fire Dept.	High	2022-25	>$250,000	City of Somerville
AA) Develop a resilient Communications System; conduct a feasibility study of installing Bi-Directional Amplifiers in high-rise buildings	IT Dept / Dept of Public Works	High	2022-25	$100,000-$250,000	City of Somerville
BB) Prepare an Asset Management Database of municipal facilities to prioritize replacement of facilities based on the likelihood and consequences of failure	DPW/Engineering/ Emergency Management	Medium	2022-25	<$100,000 /Staff time	City of Somerville
EXTREME HEAT HAZARDS					
CC) *Conduct Sanitary Code enforcement, rental inspections to address energy and flood standards; functioning windows, mold, and air conditioning*	OSPCD-Housing Division, Office of Sustainability and Environment / Inspectional Services Dept.	Medium	2023-26	>$250,000/Staff time	City of Somerville; Other outside funding TBD
DD) Enhance the ability for city facilities and other community organizations to serve as resilient cooling/warming	Capital Projects Dept.	High	2023-26	$100,000 - $250,000	City of Somerville

Table 40: Recommended Mitigation Measures					
Somerville Mitigation Recommendations					
Mitigation Action	**Lead Agency**	**Priority**	**Estimated Timeframe 2022-26**	**Estimated Cost**	**Potential Funding Sources**
centers with provisions for backup power and hardening against natural hazards; provide diverse activities for residents at cooling centers					
EE) The City should promote Solar, Heat Pumps, battery backup in new development	Office of Sustainability and Environment / Office of Strategic Planning & Comm. Development	Medium	2022-26	<$100,000 /Staff time	City of Somerville Private property developers
FF) Develop a resilient notification and public information system in multiple languages that works despite natural hazards impacts in Somerville.	Emergency Management / Office of Sustainability and Environment/ Communications	High	2023-26	<$100,000 /Staff time	City of Somerville
GG) Increase tree planting city-wide; implement the Urban Forestry Plan	Office of Sustainability and Environment	High	2022-26	>$250,000	City of Somerville
HH) The City should adopt policies that require or incentivize the use of lighter-colored building materials, green roofs, the dedication of part of a development area as open space, and planting street trees.	Office of Sustainability and Environment / Office of Strategic Planning & Comm. Development	Medium	2023-26	<$100,000 /Staff time	City of Somerville

Table 40: Recommended Mitigation Measures					
Somerville Mitigation Recommendations					
Mitigation Action	**Lead Agency**	**Priority**	**Estimated Timeframe 2022-26**	**Estimated Cost**	**Potential Funding Sources**
DROUGHT HAZARDS					
II) Provide landscaping guidance for use of native plant species and drought-tolerant plants	OSPCD-Public Space and Urban Forestry Division Office of Sustainability and Environment	Low	2022-26	<$100,000 /Staff time	City of Somerville
JJ) The City should require enhanced water conservation measures in drought emergencies, such as: ▪ *Develop an ordinance to restrict the use of public water resources for non-essential usage, such as landscaping, washing cars, filling pools etc.* ▪ *Adopt an ordinance to prioritize or control water use, particularly for emergency situations like firefighting.*	DPW/Inspectional Services / Office of Sustainability and Environment	Medium	2023-26	<$100,000 /Staff time	City of Somerville
KK) The City should encourage citizens through public outreach to use water-saving measures, such as: ▪ *Installing low-flow showerheads and toilets* ▪ *Adjusting sprinklers to water the lawn and not the sidewalk or street.* ▪ *Running dishwashers and*	Office of Sustainability and Environment / Communications Dept.	Medium	2023-26	<$100,000 /Staff time	City of Somerville

Table 40: Recommended Mitigation Measures					
Somerville Mitigation Recommendations					
Mitigation Action	**Lead Agency**	**Priority**	**Estimated Timeframe 2022-26**	**Estimated Cost**	**Potential Funding Sources**
washing machines only when they are full. ▪ *Checking for leaks in plumping or faucets.* ▪ *Installing rain-capturing devices for irrigation.* ▪ *Encouraging the installation of graywater systems in homes to encourage water reuse.*					

REGIONAL AND INTER-COMMUNITY CONSIDERATIONS

Some hazard mitigation issues are strictly local. The problem originates primarily within the municipality and can be solved at the municipal level. Other issues are inter-community and require cooperation between two or more municipalities. There is a third level of mitigation which is regional and may involve a state, regional or federal agency, or three or more municipalities.

REGIONAL PARTNERS

In urban communities like Somerville, mitigating natural hazards, particularly flooding, is usually more than a local issue. The City is within the larger watershed of the Mystic River, and drainage infrastructure is a complex system of storm drains, roadway drainage structures, pump stations and other facilities owned and operated by multiple agencies including the City, the Massachusetts Department of Transportation (MassDOT), the Massachusetts Bay Transportation Authority (MBTA), and the Massachusetts Water Resources Authority (MWRA). The planning, construction, operation, and maintenance of these structures are integral to the flood hazard mitigation efforts of the City. In Somerville there is also a major dam, Amelia Earhart, as well as several parks owned by the Massachusetts Department of Conservation and Recreation (DCR). These agencies should be considered the City's regional partners in hazard mitigation. These agencies also operate under similar constraints as communities do, including budgetary and staffing constraints, and they must make decisions about numerous competing priorities.

OVERVIEW OF REGIONAL FACILITIES WITHIN SOMERVILLE

Major facilities owned, operated, and maintained by state or regional entities include:
State Routes 93, 16, 28, and 38 (MassDOT)

- Commuter Rail lines to Lowell and Fitchburg (MBTA)
- Red Line (Davis Sq. station), Orange Line, and soon Green Line with multiple stations (MBTA)
- Sewer interceptors and Combined Sewer Overflow facilities (MWRA)
- Amelia Earhart Dam (DCR)
- State parks: Alewife Brook Reservation, Dilboy Auxiliary Fields, Memorial Stadium & Pool, Draw 7 Park, Foss Park, Mystic River Reservation, Sylvester Baxter Riverfront Park (DCR)

INTER-COMMUNITY AND REGIONAL COLLABORATION

Somerville is actively collaborating with surrounding communities, and regional organizations such as the Mystic River Watershed Association and the Metropolitan Area Planning Council on climate resiliency. The two most significant efforts are the Metro Mayors' Climate Preparedness Task force and the Resilient Mystic Collaborative, as summarized below:

Metro Mayors' Climate Preparedness Task Force

The task force was established in 2015 to provide a platform for regional coordination and integration of mitigation and resilience work across fourteen member communities in Greater Boston. Somerville has benefitted from the region's commitment to climate action and the City makes every effort to ensure consistency with other climate change efforts throughout the region.

Some of the main regional concerns include the following:

• **The Amelia Earhart Dam** is expected to be flanked on a regular basis during a 100-year storm event by 2035; by 2070 it will be overtopped during those events, assuming no additional improvement to its current structure or operations.

• **Major regional transportation corridors,** such as I-93 and Route 28, as well as the Orange line, Red line, and the Green Line Extension, are likely to experience significant impacts from coastal flooding, cutting off portions of the regional transportation system.

• **Increased average temperatures** combined with longer and more intense heat waves may increase electricity demand for cooling and could result in regional brown outs.

• **Both the New England Produce Center (in Chelsea) and the Boston Market Terminal (in Everett)** are highly vulnerable to coastal flooding; impacts to these facilities could pose serious threats to the availability of fresh food throughout the region.

Significant actions will be required by the State and Federal government, utilities, and other regional entities (such as ISO New England) to address certain infrastructure system vulnerabilities that are outside of Somerville's direct control. Somerville can work with other impacted municipalities to become a powerful advocate for appropriate policies and projects to reduce regional vulnerabilities that impact Somerville residents and businesses.

Resilient Mystic Collaborative: Lower Mystic Regional Climate Assessment

This project was carried out by the cities of Boston, Chelsea, Everett, Revere, Somerville, and Winthrop, which are members Resilient Mystic Collaborative. The Mystic River Watershed Association and several Community Based Organizations and consultants assisted with the project. See the summary in Figure 27 below, and a description of the project in Section 6, Existing Mitigation Measures.

Figure 27: Summary of the Resilient Mystic Collaborative

About the Lower Mystic Watershed

Geographic Location

The Lower Mystic is defined as the saltwater portion of the Mystic River, extending from below the Amelia Earhart Dam to Deer Island. It includes the municipalities of Somerville, Everett, Chelsea, Boston (which includes the neighborhoods of Charlestown and East Boston), Winthrop, and Revere (Figure 1).

Figure 1. Location and extent of the Lower Mystic River Watershed (courtesy Mystic River Watershed Association).

Flooding in the Lower Mystic

Low lying areas throughout the Lower Mystic already flood in the present-day during astronomical high tides called King Tides. The frequency and intensity of flooding in the Lower Mystic is only expected to increase throughout the 21st century, posing increasing risk to both residents and the critical infrastructure on which they rely.

Resilient Mystic Collaborative

In September 2018, with generous support from the Barr Foundation, what became the Resilient Mystic Collaborative was launched with ten founding communities. Within 18 months, the RMC grew to 19 communities covering 95 % of the watershed, and raised over $1.7 million for regional climate resilience projects.

Today, the Resilient Mystic Collaborative (RMC) is a partnership among 20 neighboring communities in Greater Boston's Mystic River Watershed, founded out of a sense of urgency and commitment by municipal staff to work across boundaries to protect the region's people and places from climate-intensified risks.

Source: Lower Mystic Regional Climate Assessment, 2021

SECTION 9: PLAN ADOPTION & MAINTENANCE

PLAN ADOPTION

The *Somerville Hazard Mitigation Plan 2022 Update* was adopted by the Somerville City Council on *[ADD DATE]*. See Appendix D for documentation. The plan was approved by FEMA on [*ADD DATE*] for a five-year period that will expire on [*ADD DATE*].

PLAN MAINTENANCE

MAPC worked with the Somerville Hazard Mitigation Team to prepare this plan. This group will continue to meet on an as-needed basis to coordinate the implementation and maintenance of this plan. A member of the City staff will be designated as the team coordinator. Additional members could be added to the local team from businesses, non-profits, and institutions. The city will encourage public participation during the next 5-year planning cycle. As updates and a review of the plan are conducted by the Hazard Mitigation Team, these will be placed on the City's web site, and any meetings of the Hazard Mitigation Team will be publicly noticed in accordance with city and state open meeting laws.

IMPLEMENTATION AND EVALUATION SCHEDULE

Mid-Term Survey on Progress – The coordinator of the Hazard Mitigation Team will prepare and distribute a survey in year three of the plan. The survey will be distributed to all the local team members and other interested local stakeholders. The survey will poll the members on progress and accomplishments for implementation, any new hazards or problem areas that have been identified, and any changes or revisions to the plan that may be needed.

This information will be used to prepare a report or addendum to the local hazard mitigation plan in order to evaluate its effectiveness in meeting the plan's goals and identify areas that need to be updated in the next plan. The Hazard Mitigation Implementation Team will have primary responsibility for tracking progress, evaluating, and updating the plan.

The City of Somerville will work to integrate the content of the Hazard Mitigation Plan into other planning efforts including the Somerville Climate Forward initiative. This integration will enable more timely annual reports of mitigation action status.

Begin to Prepare for the next Plan Update – FEMA's approval of this plan is valid for five years, by which time an updated plan must be approved by FEMA in order to maintain the City's approved plan status and its eligibility for FEMA mitigation grants. Given the lead time needed to secure funding and conduct the planning process, the Hazard Mitigation Implementation Team will begin to prepare for an update of the plan in year three. This will help the City avoid a lapse in its approved plan status and grant eligibility when the current plan expires.

The Hazard Mitigation Implementation Team will use the information from the Mid-Term progress review to identify the needs and priorities for the plan update and seek funding for the plan update process. Potential sources of funding may include FEMA Building Resilient Infrastructure and Communities (BRIC) grants and the Hazard Mitigation Grant Program. Both grant programs can pay for 75% of a planning project, with a 25% local cost share required.

Prepare and Adopt an Updated Local Hazard Mitigation Plan – Once the resources have been secured to update the plan, the Hazard Mitigation Team may decide to undertake the update themselves, contract with the Metropolitan Area Planning Council to update the plan or to hire another consultant. However, if the Hazard Mitigation Implementation Team decides to update the plan, the city will need to review the current FEMA hazard mitigation plan guidelines for any changes in requirements for hazard mitigation plans since the previous plan. Once the next plan update is prepared, the City will submit it to MEMA and FEMA for review and approval and adopt the plan update in order to obtain formal FEMA approval of the plan.

INTEGRATION OF THE PLANS WITH OTHER PLANNING INITIATIVES

Upon approval of the Somerville Hazard Mitigation Plan 2022 Update by FEMA, the Local Hazard Mitigation Team will provide all interested parties and implementing departments with a copy of the plan and will initiate a discussion regarding how the plan can be integrated into that department's ongoing work. At a minimum, the plan will be reviewed and discussed with the following departments:

- Fire Department
- Emergency Management
- Police Department
- Department of Public Works
- Strategic Planning and Community Development
- Office of Sustainability and Environment
- Somerviva Office of Immigrant Affairs
- Engineering
- Capital Projects Division
- Conservation Commission
- Infrastructure and Asset Management Department
- Health and Human Services Department

Other groups that will be coordinated with include large institutions, Chambers of Commerce, Community Based Organizations, and the Mystic River Watershed Association. The plan will also be posted on the City's website. The posting of the plan on the website will include a mechanism for citizen feedback such as an e-mail address to send comments.

The City of Somerville has taken steps to implement findings from the 2016 Hazard Mitigation Plan into the following policy, programmatic areas, and plans: the Climate Change Vulnerability Assessment (2017), Somerville Climate Forward Plan (2018), Climate Forward progress reports (2019 and 2020), the Zoning overhaul (2019), the Urban Forestry Plan (2020), Keep Cool Somerville (2021), and the Lower Mystic Regional Climate Plan (2021).

SECTION 10: LIST OF REFERENCES AND NOTES

City of Somerville, Climate Change Vulnerability Analysis, 2017

City of Somerville, Somerville Climate Forward, 2018

City of Somerville, Somerville Climate Forward Progress Report, 2019

City of Somerville, Somerville Climate Forward Progress Report, 2020

City of Somerville, Keep Cool Somerville, 2021

City of Somerville, Open Space and Recreation Plan, 2016

Cit of Somerville, Sewer Division, Catch Basin Inspection, Cleaning, and Maintenance

City of Somerville, Urban Forest Management Plan, Draft, 2020

City of Somerville Zoning Ordinances

Blue Hill Observatory

City of Cambridge Climate Change Vulnerability Assessment

Climate Ready Boston, 2016

FEMA, Flood Insurance Rate Maps for Norfolk County, MA, 2012

FEMA, Hazards U.S. Multi-Hazard

FEMA, Local Mitigation Plan Review Guide, October 2011

Fourth National Climate Assessment, 2018

Massachusetts Drought Management Plan, 2019

Massachusetts Office of Coastal Zone Management Shoreline Change Data

Massachusetts Office of Dam Safety, Inventory of Massachusetts Dams 2018

Massachusetts State Hazard Mitigation Plan, 2013

Massachusetts State Hazard Mitigation and Climate Adaptation Plan, 2018

Metropolitan Area Planning Council, GIS Lab, Regional Plans and Data

National Weather Service

Nevada Seismological Library

New England Seismic Network, Boston College Weston Observatory, http://aki.bc.edu/index.htm

NOAA National Centers for Environmental Information

Northeast Climate Adaptation Science Center

Northeast States Emergency Consortium, http://www.nesec.org/

Resilient Mystic Collaborative, Lower Mystic Regional Climate Assessment, 2021

US Census, 2020 and American Community Survey 2019 5-Year Estimates

USGS, National Water Information System

Notes on Renter Vulnerability section (pages 100-101)

[1] 780 C.M.R. (1975).

[2] 2012-2016 American Community Survey 5-Year Estimates: Somerville, MA, U.S. Census Bureau (last accessed 12/2018).

[3] Advancing Health Equity Through Housing Law and Policy Webinar, The Network for Public Health Law, University of Wisconsin Population Health Institute, countyhealthrankings.org, July 16, 2019. Accessed through https://www.countyhealthrankings.org/learn-from-others/webinars/advancing-health-equity-through-housing-law-and-policy (last accessed 08/06/2020).

[4] On average, 37 percent of Somerville households are experiencing at least one of four problems leading to disproportionate housing needs. These include "cost burden, severe cost burden, overcrowding, and substandard housing conditions." 24 C.F.R. § 5.152. More than half of Hispanic, Black, non-Hispanic and Native American, Non-Hispanic households and families in Somerville are experiencing at least one of the four problems. Over 40 percent of both Asian or Pacific Islander and Non-Hispanic and Other, Non-Hispanic, and non-family Somerville households are experiencing at least one of four problems. This is compared to just over one-third of White, non-Hispanic households facing one of the four problems, despite making up three-quarters of the City's population. Assessment of Fair Housing, Office of Strategic Planning and Community Development-Housing Division, City of Somerville, pp. 15, 45-48, October 2017. Accessed through www.somervillema.gov/sites/default/files/assessment-of-fair-housing-2017.pdf (last accessed 07/28/2020).

[5] References results from a voluntary survey of landlords conducted by the City of Somerville Office of Sustainability and Environment in 2019; In Massachusetts, an estimated 75-79 percent of tenants pay for electricity separately from rent. Riordan Frost, New Strains on Home Utilities During the Pandemic, Harvard Joint Center for Housing Studies, July 23, 2020. Accessed through https://www.jchs.harvard.edu/blog/new-strains-on-home-utilities-during-the-pandemic/ (last accessed 08/05/2020).

[6] "According to the SomerVision Comprehensive Plan, over 60 percent of the Somerville housing stock was constructed prior to 1940, posing higher risk for environmental safety concerns such as lead and state of disrepair or aging systems as the housing stock gets older." Wellbeing of Somerville Report, Health and Humans Services Department, City of Somerville, pp. 37, 2017. Accessed through https://www.somervillema.gov/sites/default/files/wellbeing-of-somerville-report-2017.pdf (last accessed 08/12/2020).

[7] Michael Carliner, America's Rental Housing: Reducing Energy Costs in Rental Housing-The Need and the Potential, Joint Center for Housing Studies of Harvard University, Research Brief 13-2 at pp. 1-4, December 2013. Accessed through https://www.jchs.harvard.edu/sites/default/files/carliner_research_brief_0.pdf (last accessed 07/07/2020).

[8] A "typical renter directly paid...four percent of household income for energy use in 2011...For lowest-income renters, tenant-paid household energy costs represent 15 percent of income." Id. at 1. See also Ariel Drehobl, Lauren Ross, Lifting the High Energy Burdens in America's Largest Cities: How Energy Efficiency Can Improve Low-Income and Underserved Communities, American Council for Energy Efficiency, pp. 9, April 20, 2016. Accessed through (https://www.aceee.org/research-report/u1602last accessed 08/06/2020).

9 Supra note 11 at 1.

10 Sneha Ayyagari, Equity and Climate: A Solution for Home Rentals, Rocky Mountain Institute, November 19, 2017. Accessed through https://rmi.org/equity-and-climate-a-solution-for-home-rentals/ (last accessed 08/06/2020).

[11] Supra note 7 at 9-13.

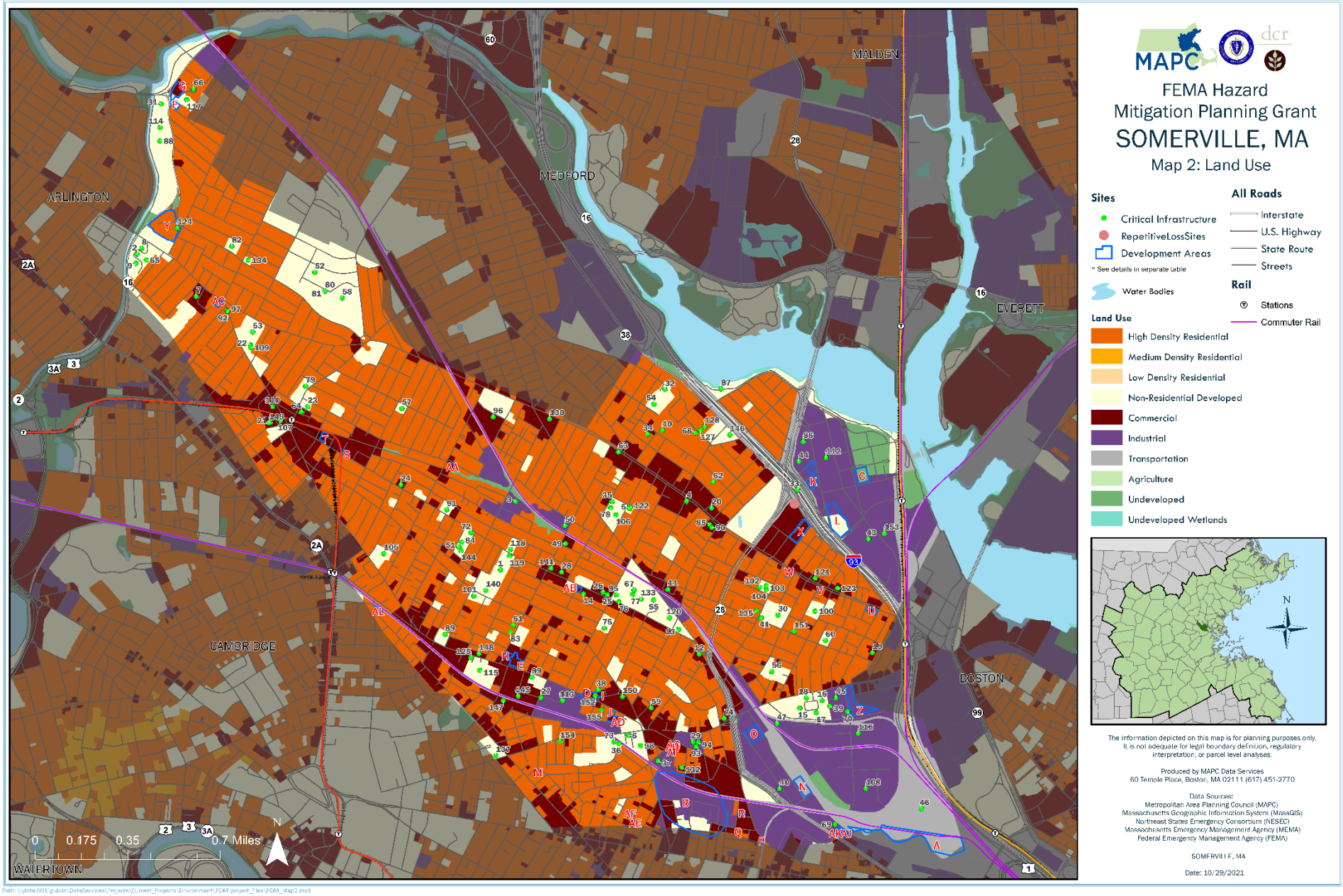
[12] Id. at 11.

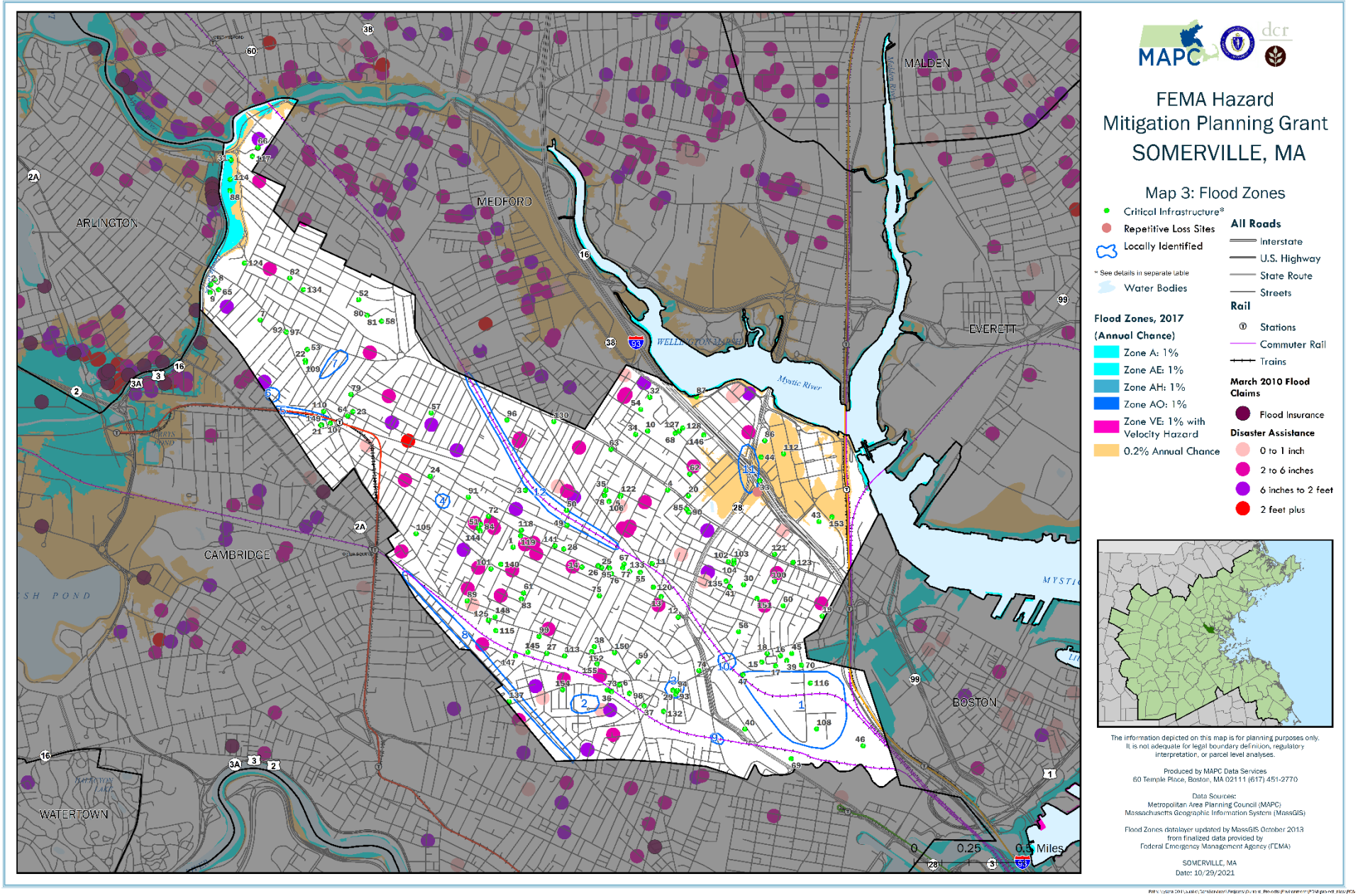
[13] Id. at 9-13, 15, 110.

APPENDIX A: HAZARD MAPPING

bbb


MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
SOMERVILLE, MA
Map 1: Population Density
Sites
Critical Infrastructure*
Development Areas
* See details in separate table
Water Bodies
Population Density
Census 2010 Blocks
People per acre
0 or No Data
0.1 - 5.0
5.1 - 15.0
15.1 - 30.0
More than 30
All Roads
Interstate
U.S. Highway
State Route
Street
Rail
Stations
Commuter Rail
ARLINGTON
MEDFORD
MALDEN
EVERETT
CAMBRIDGE
BOSTON
WATERTOWN
0 0.25 0.5 Miles
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
SOMERVILLE, MA
Date: 10/29/2021


MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
SOMERVILLE, MA
Map 2: Land Use
Sites
Critical Infrastructure
RepetitiveLossSites
Development Areas
* See details in separate table
Water Bodies
All Roads
Interstate
U.S. Highway
State Route
Streets
Rail
Stations
Commuter Rail
Land Use
High Density Residential
Medium Density Residential
Low Density Residential
Non-Residential Developed
Commercial
Industrial
Transportation
Agriculture
Undeveloped
Undeveloped Wetlands
ARLINGTON
MEDFORD
MALDEN
EVERETT
CAMBRIDGE
BOSTON
WATERTOWN
0 0.175 0.35 0.7 Miles
N
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analyses.
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
SOMERVILLE, MA
Date: 10/29/2021


MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
SOMERVILLE, MA
Map 3: Flood Zones
Critical Infrastructure*
Repetitive Loss Sites
Locally Identified
* See details in separate table
Water Bodies
Flood Zones, 2017
(Annual Chance)
Zone A: 1%
Zone AE: 1%
Zone AH: 1%
Zone AO: 1%
Zone VE: 1% with Velocity Hazard
0.2% Annual Chance
All Roads
Interstate
U.S. Highway
State Route
Streets
Rail
Stations
Commuter Rail
Trains
March 2010 Flood Claims
Flood Insurance
Disaster Assistance
0 to 1 inch
2 to 6 inches
6 inches to 2 feet
2 feet plus
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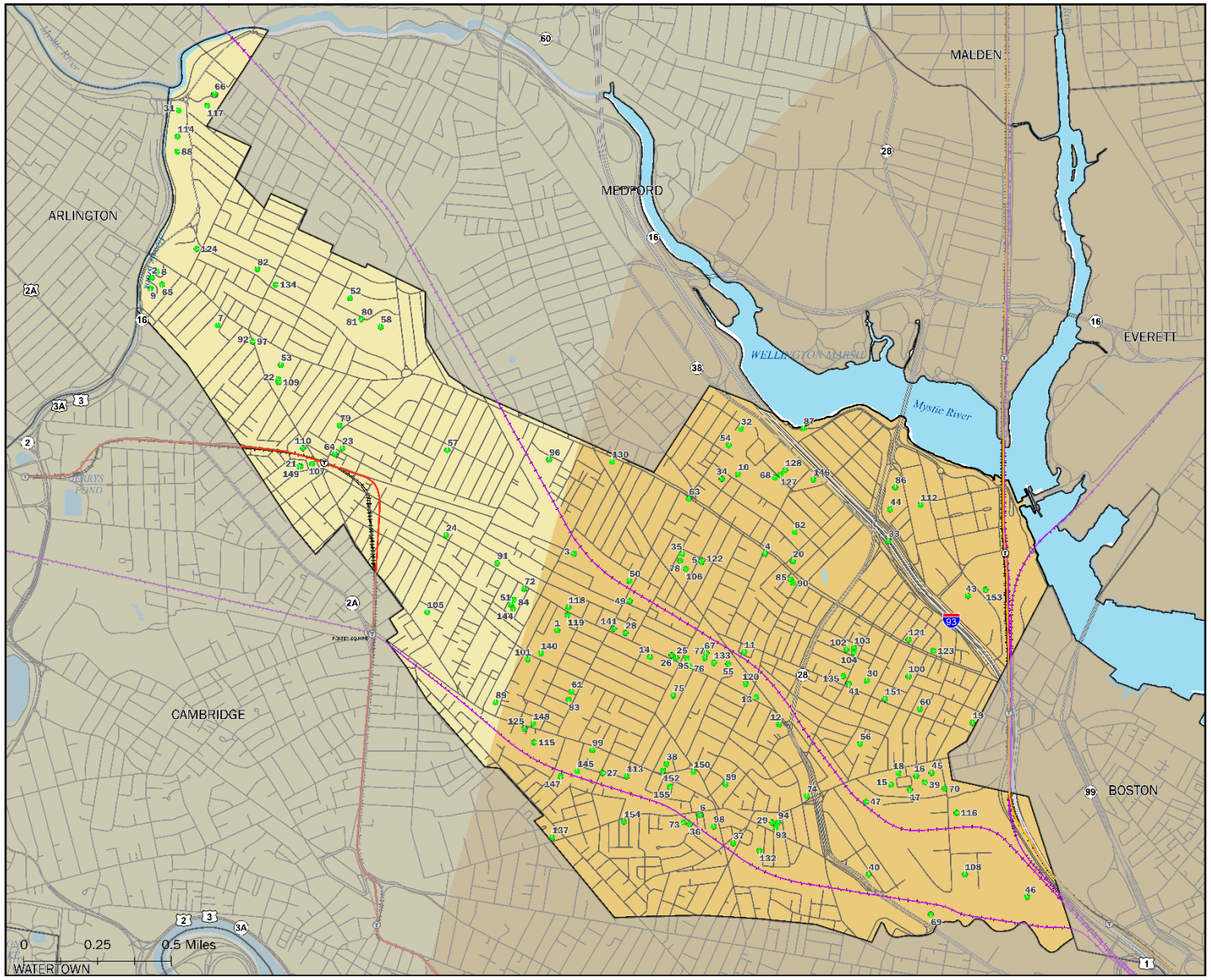
Produced by MAPC Data Services
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Flood Zones datalayer updated by MassGIS October 2013 from finalized data provided by Federal Emergency Management Agency (FEMA)
SOMERVILLE, MA
Date: 10/29/2021
ARLINGTON
MEDFORD
MALDEN
EVERETT
CAMBRIDGE
BOSTON
WATERTOWN
Mystic River
0 0.25 0.5 Miles



MAPC dcr

FEMA Hazard Mitigation Planning Grant

SOMERVILLE , MA

Map 4: Landslides

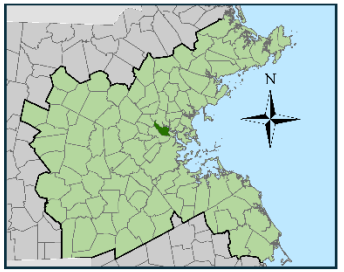
Sites
- Critical Infrastructure Sites*
- * See details in separate table
- Train Stations
- Commuter Rail Lines
- Trains

Water Bodies

All Roads
- Interstate
- U.S. Highway
- State Route
- Street

Earthquakes
- Epicenters

Landslides
- High landslide incidence (greater than 15% of the area is involved in landsliding)
- High susceptibility to landsliding and moderate incidence
- High susceptibility to landsliding and low incidence
- Moderate susceptibility to landsliding and low incidence
- Low landslide incidence (less than 1.5 % of the area is involved in landsliding



The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel-level analyses.

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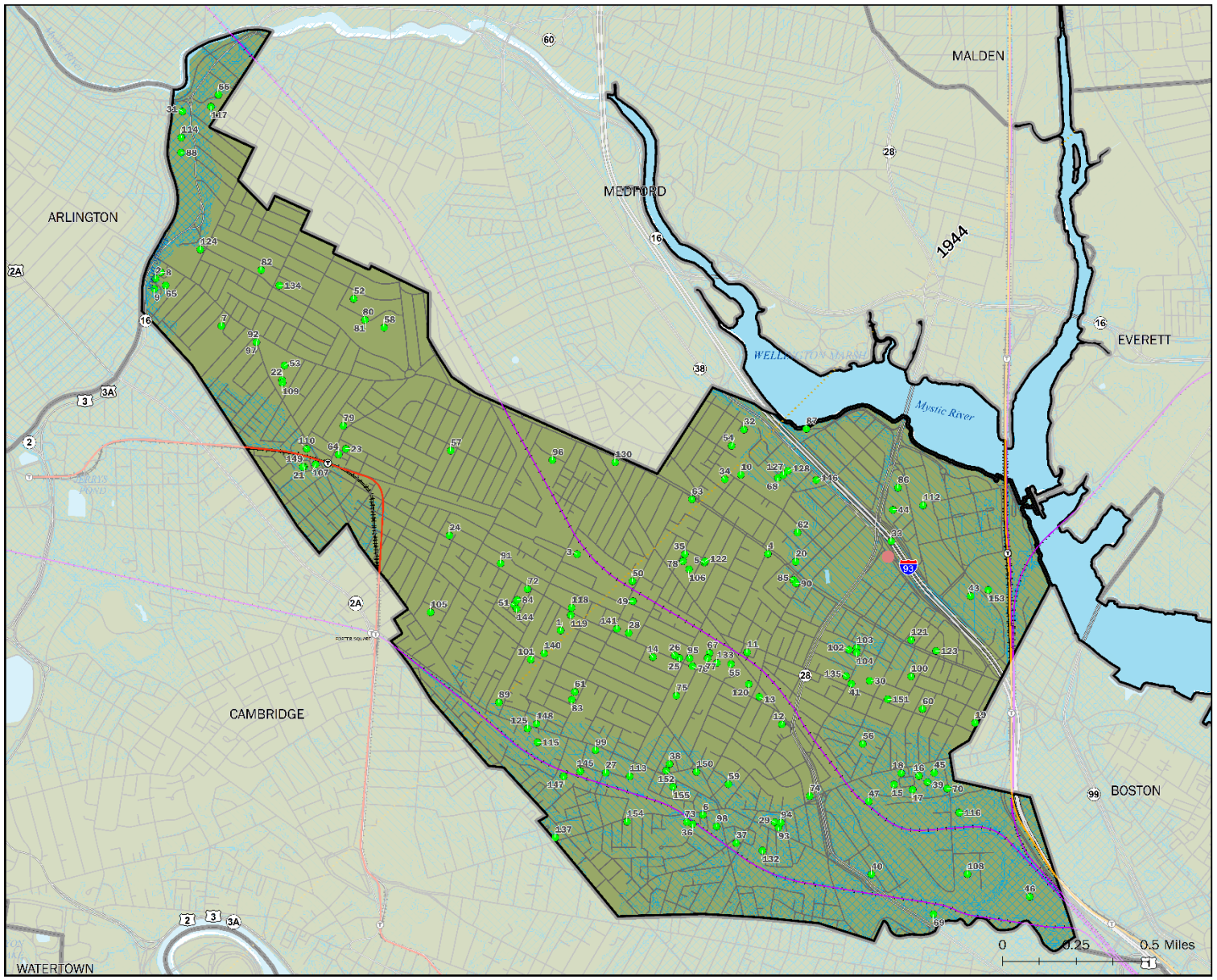
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
U.S. Geological Survey (USGS)

Date: 12/15/2021
SOMERVILLE, MA



MAPC dcr

FEMA Hazard Mitigation Planning Grant

SOMERVILLE , MA

Map 5: Hurricanes

Sites
- Critical Infrastructure Sites*
- Repetitive Loss Sites
- * See details in separate table
- Train Stations
- Commuter Rail Lines
- Trains

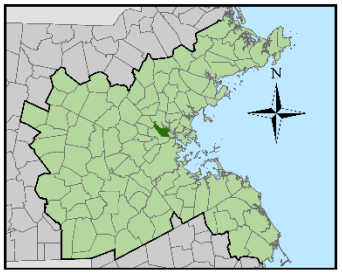
Tornadoes
- Tornado

Storm Tracks
- Tropical Depression
- Tropical Storm
- Category 1 Hurricane
- Category 2 Hurricane
- Category 3 Hurricane

Year of storm noted on map

- Hurricane Surge Inundation Area
- Water Bodies

100 Year Wind Speeds
Miles Per Hour
- 90 MPH
- 100 MPH
- 110 MPH
- 120 MPH
- 130 MPH



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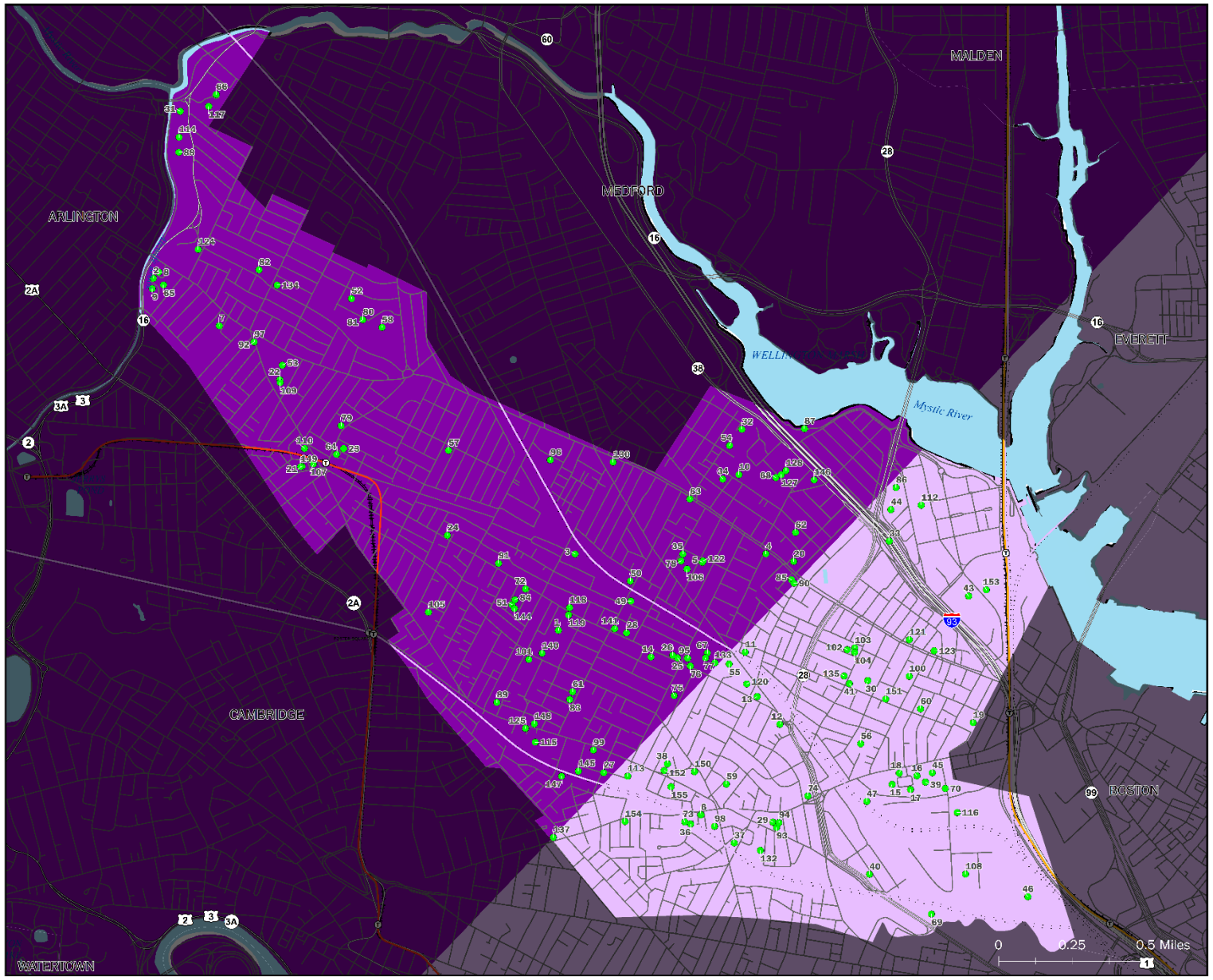
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
National Oceanographic and Atmospheric Administration (NOAA)
Date: 12/15/2021



MAPC dcr

FEMA Hazard Mitigation Planning Grant
SOMERVILLE, MA

Map 6: Average Snowfall

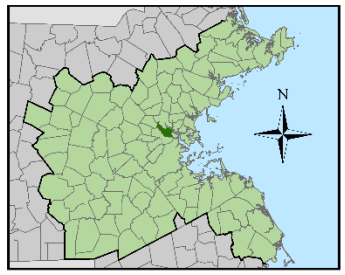
Sites
- Critical Infrastructure Sites*

* See details in separate table

Average Annual Snowfall
- 36.1 to 48.0 inches
- 48.1 to 72.0 inches

- Water Bodies
- Train Stations
- Commuter Rail Lines
- Trains

All Roads
- Interstate
- U.S. Highway
- State Route
- Street



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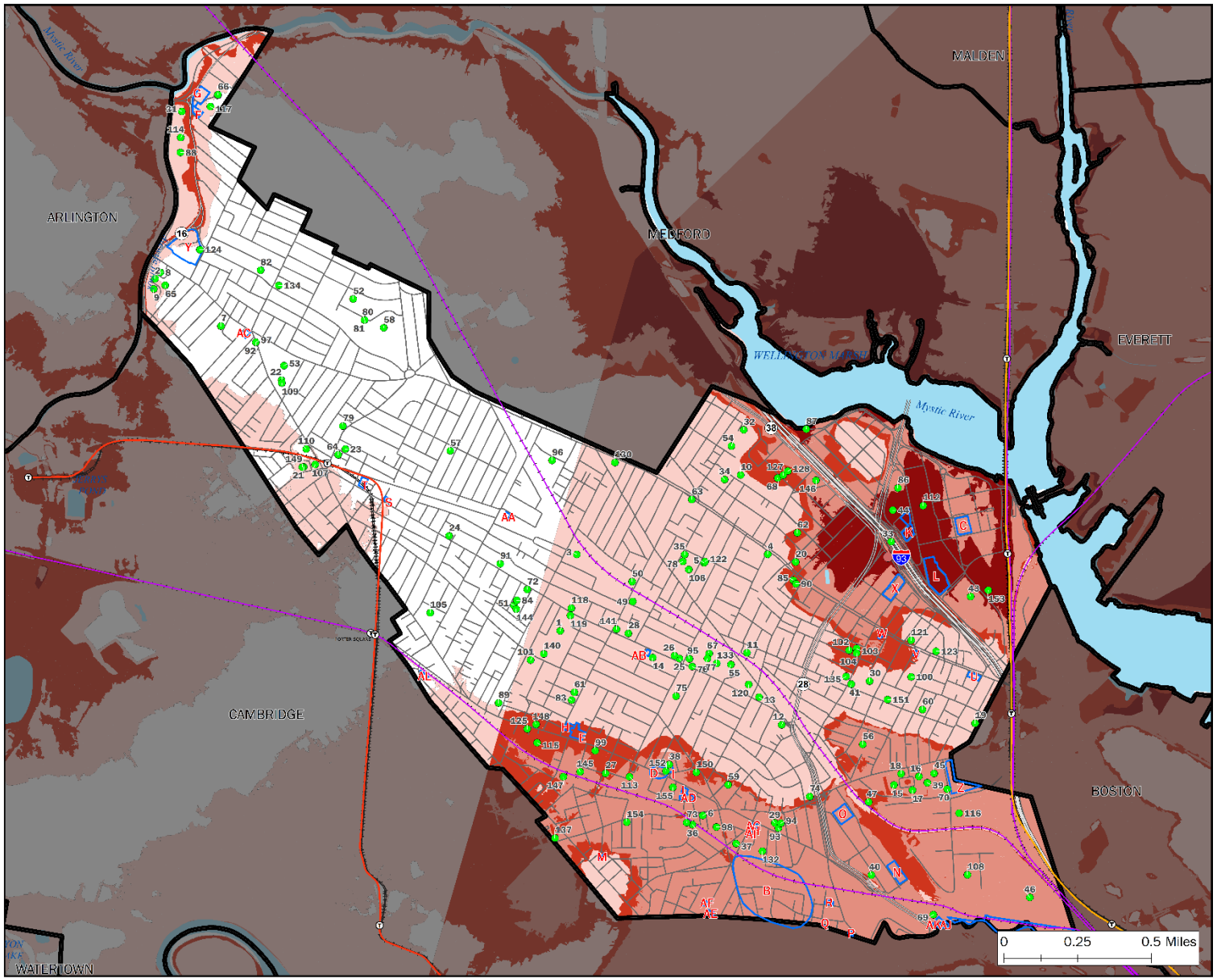
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)

SOMERVILLE, MA

Date: 10/29/2021



MAPC dcr

FEMA Hazard Mitigation Planning Grant

SOMERVILLE, MA

Map 7: Composite Natural Hazards

Sites

- Critical Infrastructure
- Repetitive Loss Sites
- Development Areas
  * See details in separate table

Composite Natural Hazards

- Low (2 Hazards)
- Moderate (3 Hazards)
- High (4 Hazards)
- Very High (5 Hazards)

Composite natural hazards shown for areas of existing development. Hazards include:

- 100 year wind speed of 110 MPH or higher
- Moderate landslide risk
- FEMA flood zones (100 year and 500 year)
- Average snowfall of 36.1" or more
- Hurricane surge inundation areas

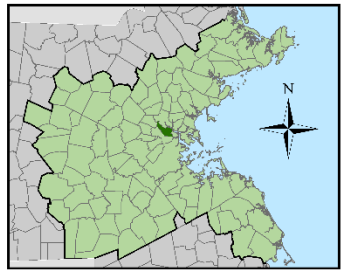
- Water Bodies

All Roads

- Interstate
- U.S. Highway
- State Route
- Street
- Train Stations
- Commuter Rail Lines
- Trains

Subway Lines

- Blue
- Green
- Orange
- Red
- Silver



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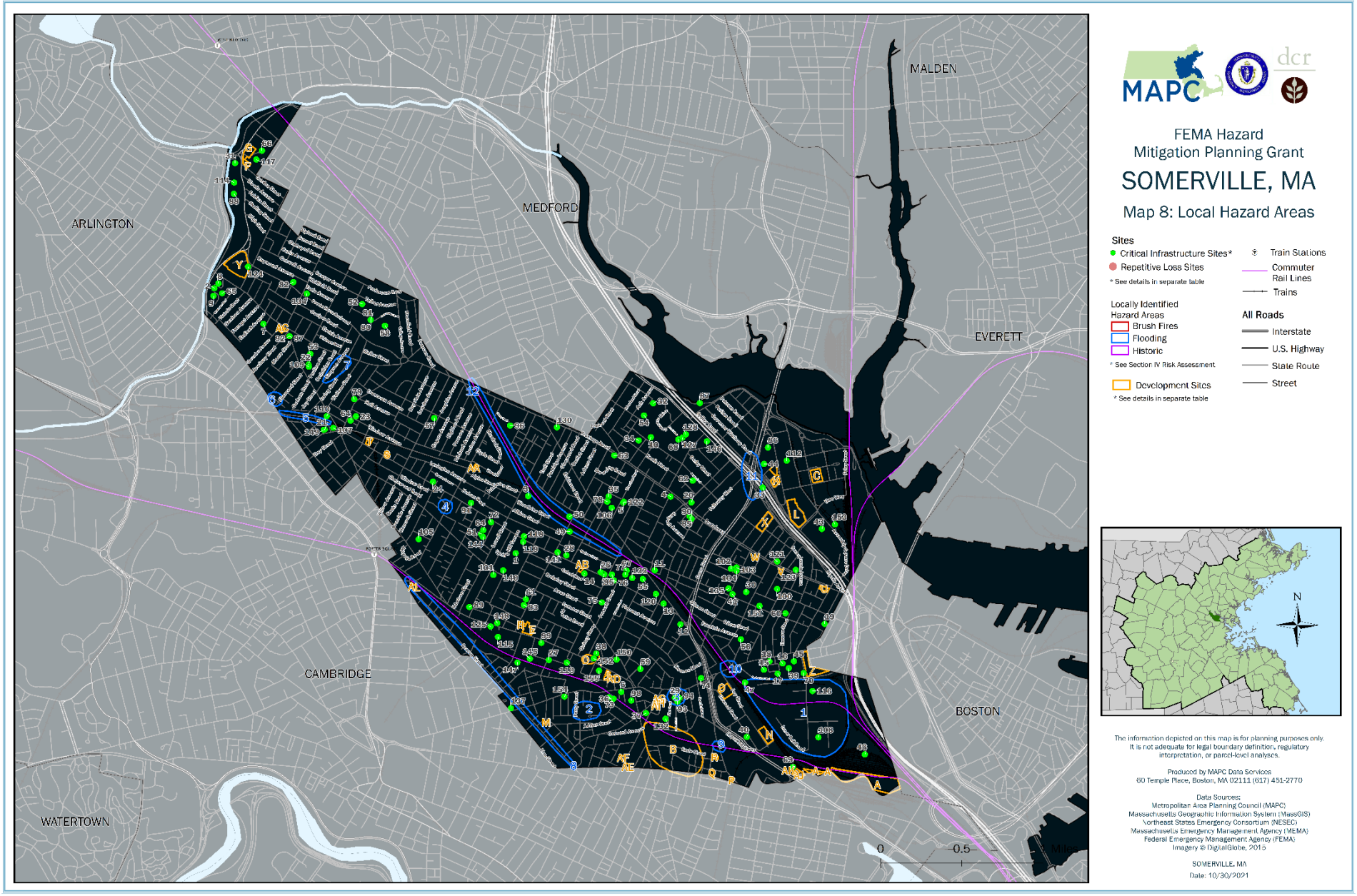
Data Sources

Composite Natural Hazard:
Wind, Landslide Risk, Snow -Northeast States Emergency Consortium (NESEC)
Flood Zones 2013 FEMA/MassGIS
Hurricane Surge - 2013 U.S. Army Corps of Engineers, New England District
Roads/Trains: MassDOT/ CTPS
Repetitive Loss Sites: DCR/Office of Flood Hazard Management
Critical Infrastructure: Metropolitan Area Planning Council (MAPC) /

SOMERVILLE, MA

Date: 10/29/2021


MALDEN
MEDFORD
ARLINGTON
EVERETT
CAMBRIDGE
BOSTON
WATERTOWN
0
0.5
MILES
MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
SOMERVILLE, MA
Map 8: Local Hazard Areas
Sites
Critical Infrastructure Sites*
Repetitive Loss Sites
* See details in separate table
Train Stations
Commuter Rail Lines
Trains
Locally Identified Hazard Areas
Brush Fires
Flooding
Historic
* See Section IV Risk Assessment
Development Sites
* See details in separate table
All Roads
Interstate
U.S. Highway
State Route
Street
N
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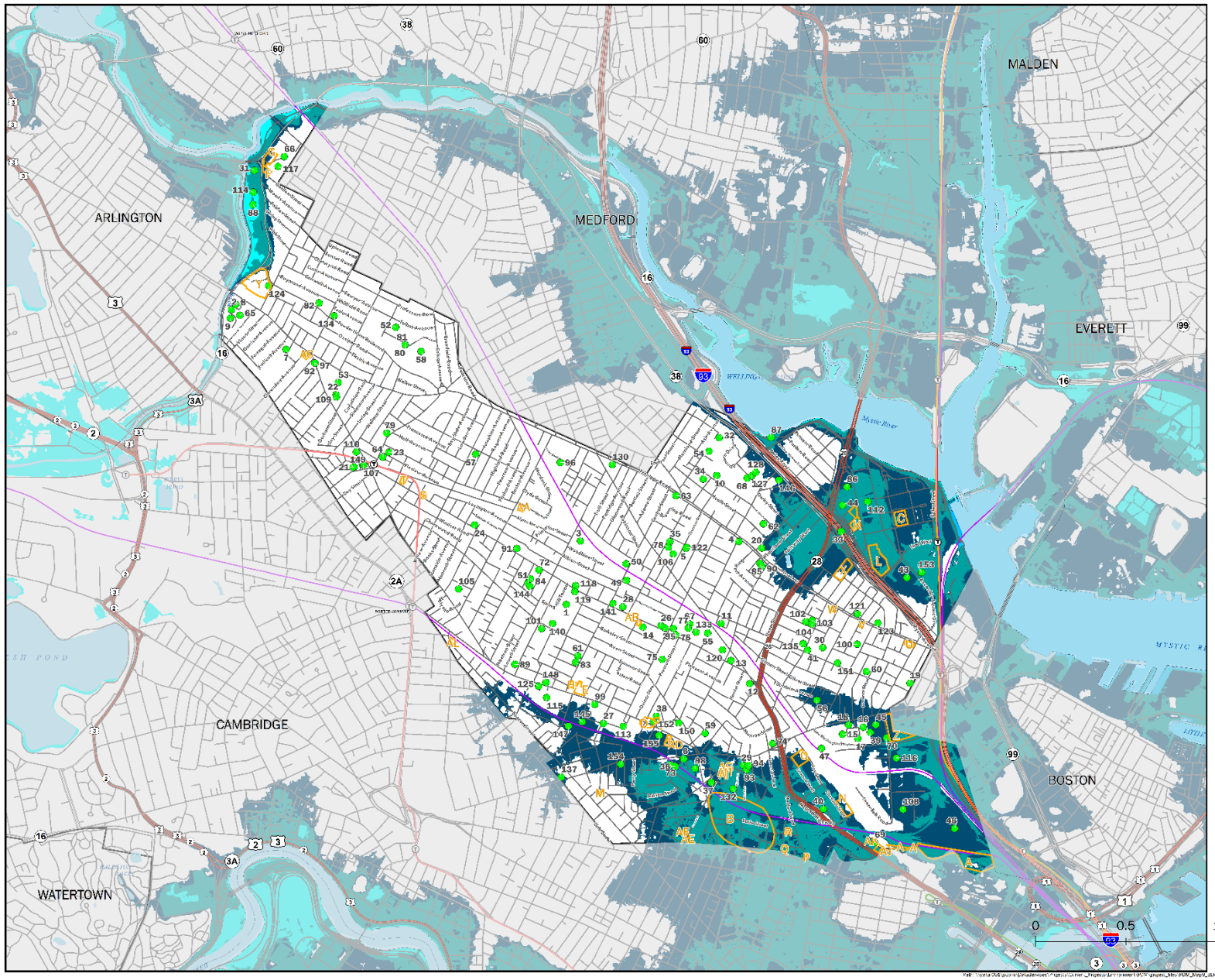
60 Temple Place, Boston, MA 02111 (617) 451-2770
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
Imagery © DigitalGlobe, 2015
SOMERVILLE, MA
Date: 10/30/2021



FEMA Hazard Mitigation Planning Grant

SOMERVILLE, MA

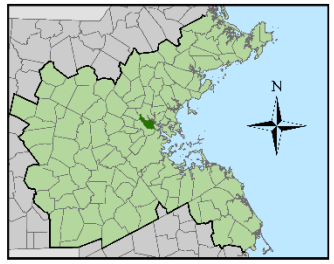
Map 9: Sea Level Rise

Sites
- Critical Infrastructure Sites*
- Repetitive Loss Sites
- Development Sites

Train Stations
- Commuter Rail Lines
- Trains

Future Coastline
- Sea Level Rise (1 ft.)
- Sea Level Rise (3 ft.)
- Sea Level Rise (6 ft.)
- Sea Level Rise (10 ft.)

All Roads
- Interstate
- U.S. Highway
- State Route
- Street



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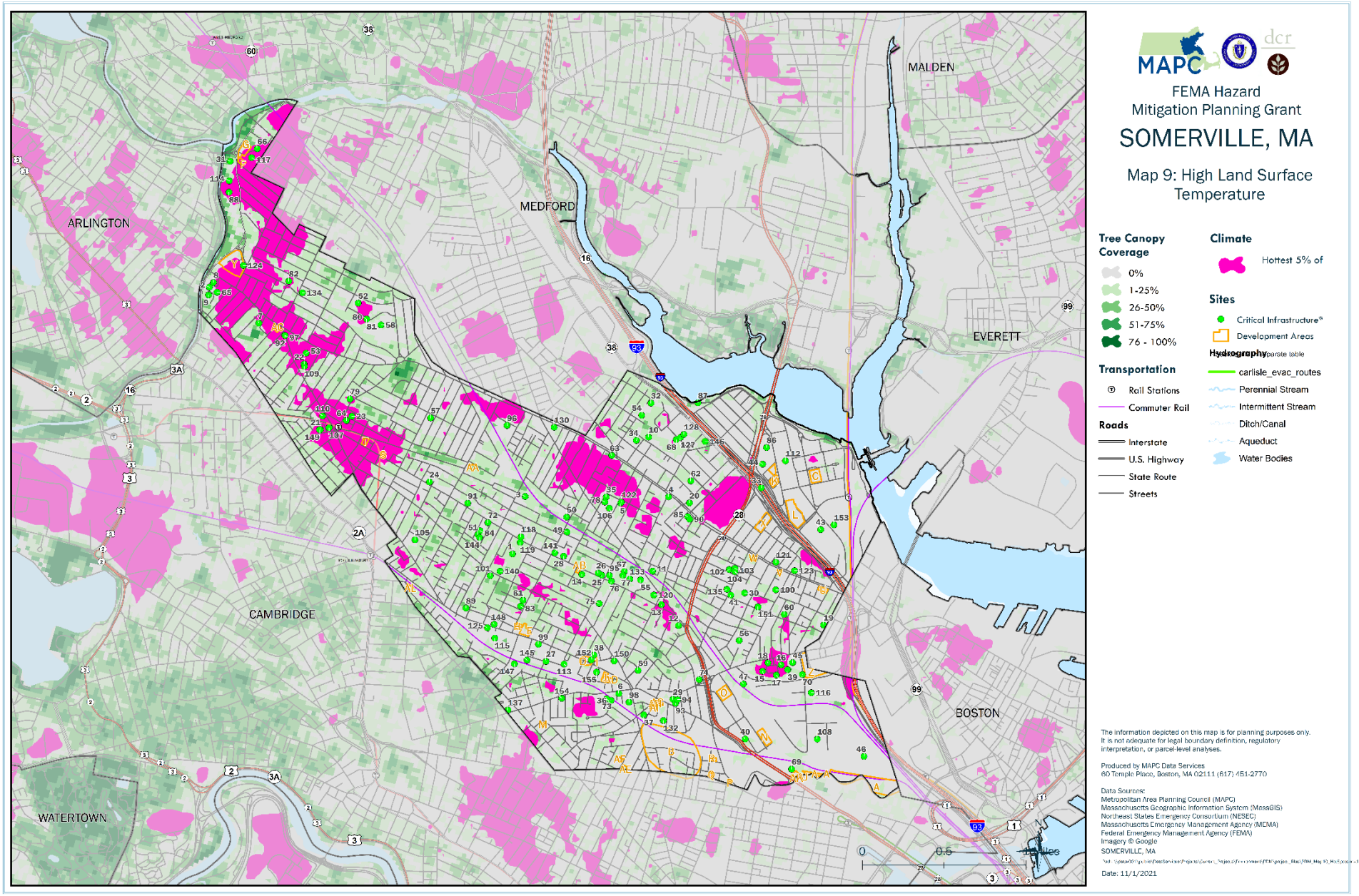
Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
Imagery © Google

0 0.5 1 Miles

SOMERVILLE, MA

Date: 10/30/2021

b


MAPC
dcr
FEMA Hazard
Mitigation Planning Grant
SOMERVILLE, MA
Map 9: High Land Surface Temperature
Tree Canopy Coverage
0%
1-25%
26-50%
51-75%
76 - 100%
Climate
Hottest 5% of
Sites
Critical Infrastructure*
Development Areas
*separate table
Hydrography
carlisle_evac_routes
Perennial Stream
Intermittent Stream
Ditch/Canal
Aqueduct
Water Bodies
Transportation
Rail Stations
Commuter Rail
Roads
Interstate
U.S. Highway
State Route
Streets
ARLINGTON
MEDFORD
MALDEN
EVERETT
CAMBRIDGE
BOSTON
WATERTOWN
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Data Sources:
Metropolitan Area Planning Council (MAPC)
Massachusetts Geographic Information System (MassGIS)
Northeast States Emergency Consortium (NESEC)
Massachusetts Emergency Management Agency (MEMA)
Federal Emergency Management Agency (FEMA)
Imagery © Google
SOMERVILLE, MA
Date: 11/1/2021
0
0.5
1 Miles

APPENDIX B: HAZARD MITIGATION TEAM MEETINGS

Somerville Hazard Mitigation Plan
Local Team Meeting #1

Wednesday, July 7, 2021
10:00 – 11:30 AM

Zoom Meeting

https://zoom.us/j/94898136792

Meeting ID: 948 9813 6792
One tap mobile
+13017158592,,94898136792#

Dial by your location
+1 301 715 8592

AGENDA

1. **Welcome and Introductions**
2. **Overview of the HMP Project**
   - Overview of the FEMA Hazard Mitigation Plan
   - Project tasks and schedule
3. **Getting Started: Local Data Updates from 2016 Plan**
   - *During the meeting we will update maps using Google MyMaps*
     - Identify Local Hazard Areas of Concern
     - New and Planned Development sites
     - Critical Facilities Inventory
4. **Public Meetings and Outreach**
   - Two Public Meetings
   - Community Survey
   - Identify local stakeholders to invite

APPENDIX B: HAZARD MITIGATION TEAM MEETINGS

Somerville Hazard Mitigation Plan
Local Team Meeting #2

Monday, September 13, 2021
10:00 – 11:30 AM

Zoom Meeting
https://zoom.us/j/98344155158

Meeting ID: 983 4415 5158
Dial by your location
+1 312 626 6799
+1 646 876 9923

AGENDA

1. **Welcome and Introductions**
2. **Review and Update of Mitigation Goals for the Plan**
   - See Goals from the 2016 plan attached
   - Revise, delete, or add new goals
3. **Review Status of Existing Mitigation Measures**
   - See summary of Existing Mitigation from 2016 plan attached
   - Note any **changes or new measures** adopted since 2016
   - Comments on **effectiveness, any changes** or **new measures** needed
4. **Community Survey**
   - Issues and questions to be addressed
   - Distribution and outreach to target audiences
5. **Prepare for First Public Meetings**
   - Date and hosting board/commission
   - *Meeting Invitation and outreach:*
     - Identify local stakeholders to invite (refer to MVP invitees?)

APPENDIX B: HAZARD MITIGATION TEAM MEETINGS

Somerville Hazard Mitigation Plan
Local Team Meeting #3

Monday, November 15, 2021
10:00 – 12:-00

Zoom Meeting
https://zoom.us/j/91726384386

Meeting ID: 917 2638 4386
Dial in numbers:
+1 301 715 8592
+1 312 626 6799

AGENDA

1. **Welcome and Introductions**

2. **Review Status of Recommended Mitigation Measures**

   - *See **Worksheet #1**, Status of Recommended Mitigation from 2016 plan*
   - Please note mitigation that has been **completed** or **partially completed**
   - For mitigation **not completed**, please note any that should be **retained** for the 2021 updated plan; and if any **revisions** are needed

3. **Update the Hazard Mitigation Strategy for the 2021 Plan**

   - *See **Worksheet #2**, Updated Mitigation Strategy*
   - Note mitigation to be **retained** from the previous plan (Worksheet 1)
   - Add any **new Mitigation Measures** (such as climate resilience)
   - Identify time frames, cost estimates, lead agencies, funding sources for each of the recommended measures

4. **Next Steps**

   - Second public meeting, review of the draft plan
   - Finalize draft plan and submit to MEMA

5. **Adjourn**

APPENDIX C: PUBLIC MEETINGS

CITY OF SOMERVILLE, MASSACHUSETTS
CONSERVATION COMMISSION
JOSEPH A. CURTATONE
MAYOR

Tuesday, October 26, 2021, 7:00 PM
Agenda
Please join this meeting from your computer, tablet or smartphone:
Registration URL :
https://attendee.gotowebinar.com/register/1019577550663240460
Webinar ID
862-440-483
TO CALL IN
UNITED STATES
+1 (562) 247-8422
Access code: 458-675-395

NOTE: Items may be called in any order, at the Chair's discretion.

Updates & Discussion:

1. Remote Meeting Instructions / Introductions
2. Somerville Hazard Mitigation Plan
3. MWRA Siphon Rehabilitation Exempt Activity
4. Letters / Notifications
5. Community Gardens Program
    a. Community Garden Discussion & Updates
6. Ongoing Projects Review
    a. Ongoing Projects Spreadsheet
7. Conservation Commission Vacancy
8. Conservation Agent Action Item Review
9. Committees & Task Force Reports
    a. Community Preservation Committee Updates
    b. Community Preservation Committee Representative
10. Approval of Minutes:
    a. July 27th, 2021
    b. September 29th, 2021

Adjourn
For more information contact Malik Drayton at Mdrayton@SomervilleMA.gov

ONE CALL to CITY HALL 3 1 1 SOMERVILLE

CITY HALL • 93 HIGHLAND AVENUE • SOMERVILLE, MASSACHUSETTS 02143
(617) 625-6600 EXT. 2500 • TTY: (617) 666-0001 • FAX: (617) 625-0722
www.somervillema.gov

APPENDIX C: PUBLIC MEETINGS

Somerville Hazard Mitigation Plan
Public Meeting

Natural hazards can have serious impacts on the City of Somerville and its residents and businesses



The City of Somerville is preparing an updated Hazard Mitigation Plan to help the City reduce its vulnerability to natural hazards such as flooding, hurricanes, and winter storms. Please join the City for a presentation about the Hazard Mitigation Plan at a public meeting hosted by the Conservation Commission. Your input and suggestions for the plan are welcome, please join us!

Tuesday, October 26, 2021
7:00 pm

Please join this meeting from your computer, tablet or smartphone:

Registration URL :
https://attendee.gotowebinar.com/register/1019577550663240460

Webinar ID: 862-440-483 TO
CALL IN: (562) 247-8422 / Access code: 458-675-395

For more information, please contact
Martin Pillsbury at mpillsbury@mapc.org

APPENDIX C: PUBLIC MEETINGS

Plan de Mitigación de Riesgos de la Ciudad de Somerville

Reunión abierta al público

Las amenazas naturales pueden impactar a la ciudad de Somerville, sus residents y sus negocios



La ciudad de Somerville está actualizando su plan de mitigación de riesgos para reducir su vulnerabilidad a amenazas naturales como lo son las inundaciones, huracanes y tormentas invernales. Acompañe a la ciudad en una presentación sobre el Plan de Mitigación de Riesgos auspiciada por la Comisión sobre Conservación. Sus aportaciones y sugerencias para el plan son bienvenidas. ¡Los esperamos!

Martes 26 de octubre, 2021
7:00 pm

Únase a esta reunión desde su computadora, tableta o teléfono:

Regístrese usando este enlace:
https://attendee.gotowebinar.com/register/1019577550663240460

Webinar ID: 862-440-483 TO
Llame al: (562) 247-8422 / Código de acceso: 458-675-395

Para mayor información, por favor contacte a Martin Pillsbury mpillsbury@mapc.org

APPENDIX C: PUBLIC MEETINGS

Somerville Hazard Mitigation Plan
Public Meeting

Natural hazards can have serious impacts on the City of Somerville and its residents and businesses

The City of Somerville has prepared an updated Hazard Mitigation Plan to help the City reduce its vulnerability to natural hazards such as flooding, hurricanes, and winter storms. Please join the City for a presentation about the Hazard Mitigation Plan at a public meeting. Your input and suggestions for the plan are welcome, please join us!

Wednesday, December 1, 2021 at 7:00 pm

Meeting online via Zoom

Click here to register:

https://tinyurl.com/somerville-meeting

You will receive an email with the Zoom link

For more information, please contact
mpillsbury@mapc.org

MAPC

APPENDIX C: PUBLIC MEETINGS

Amanda Linehan, Communications Manager, Metropolitan Area Planning Council
617-933-0705, alinehan@mapc.org

CALENDAR LISTING / MEDIA ADVISORY

SOMERVILLE'S FEMA HAZARD MITIGATION PLAN TO BE PRESENTED AT DECEMBER 1 PUBLIC MEETING

Who: Somerville residents, business owners, instututions, and non-profit organizations, and others who are interested in preventing and reducing damage from natural hazards.

What: At a public meeting on Wednesday, December 1 at 7:00 PM, a presentation on the *Somerville Draft Hazard Mitigation Plan, 2021 Update* will be hosted by the Somerville Hazard Mitigation Team. There will be an opportunity for questions and discussion following the presentation.

The City of Somerville is preparing the updated 2021 Hazard Mitigation Plan to document natural hazards that affect the City, such as floods, hurricanes, and severe winter storms, and to recommend actions that the City can take to reduce its vulnerability to these hazards.

Once completed and approved by the Federal Emergency Management Agency (FEMA), the City will be eligible for grants from FEMA that support significant mitigation projects such as drainage improvements.

When: Wednesday, December 1, 2020, 7:00 PM

Where: **Virtual meeting online via Zoom**
To register and receive the Zoom link, please visit this web page:
https://tinyurl.com/somerville-meeting
You will receive a confirmation and Zoom meeing link by email

MAPC is the regional planning agency for 101 communities in the metropolitan Boston area, promoting smart growth and regional collaboration. More information about MAPC is available at www.mapc.org.

##

APPENDIX C: PUBLIC MEETINGS

Notice of Public Meeting on Somerville Hazard Mitigation Plan, December 1, 2021, at 7:00 PM

TO: City and Town Clerks in Arlington, Boston, Cambridge, Chelsea, and Everett, MA

PUBLIC MEETING NOTICE
TOWN OF SOMERVILLE
MEETING ON HAZARD MITIGATION PLAN

The City of Somerville has prepared its draft *Hazard Mitigation Plan 2021 Update* to reduce the City's vulnerability to natural hazards such as flooding, hurricanes, and winter storms.

As part of the planning process, all neighboring communities to Somerville are being notified of a public meeting on the draft plan to be hosted by the Somerville Hazard Mitigation Team as follows:

Wednesday, December 1, 2021 at 7:00 PM
Remote meeting via Zoom. To register and receive the Zoom link:
https://tinyurl.com/somerville-meeting
The Zoom meeting link will be sent by email

A flyer announcing the meeting details and registration link is attached. If you have any questions about this, please feel free to contact me.

Best regards,

Martin Pillsbury
Director of Environmental Planning
Metropolitan Area Planning Council
60 Temple Place
Boston, MA 02111
617-939-3896
mpillsbury@mapc.org

City of **Somerville**

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Home > Programs & Initiatives > Hazard Mitigation Plan

About Somerville's Hazard Mitigation Plan

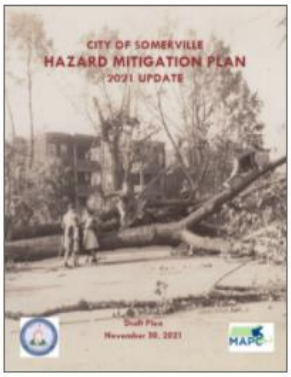
The City of Somerville has prepared an updated Hazard Mitigation Plan to help the City reduce its vulnerability to natural hazards such as flooding, hurricanes, and winter storms. The plan also addresses the impacts of climate change, and features recommended mitigation actions the City can take to become more resilient to natural hazards.

This plan was prepared for the City of Somerville by the Metropolitan Area Planning Council (MAPC) under the direction of the Massachusetts Emergency Management Agency (MEMA) and the Massachusetts Department of Conservation and Recreation (DCR). The plan was funded by the Massachusetts Emergency Management Agency (MEMA) through a FEMA grant.

November 2021 Draft

The draft Somerville Hazard Mitigation Plan 2021 Update is available for download below.

If you have any questions or would like to send a comment, please send an email to somervillehazards@mapc.org by December 10, 2021.



VIEW DRAFT

Take the Hazard Mitigation Survey by December 10, 2021

Somerville may be impacted by several kinds of natural hazards which can cause damages affecting residents and businesses. The City would like to hear your concerns and ideas for mitigating natural hazards. Please complete the City's Hazard Mitigation Survey at: https://mapc.ma/SomervilleHazardsSurvey. Your responses to this survey will be anonymous, and they will help the City develop its Hazard Mitigation Plan to increase protection from natural hazards.

Contact

VIEW ALL STAFF CONTACTS >

b

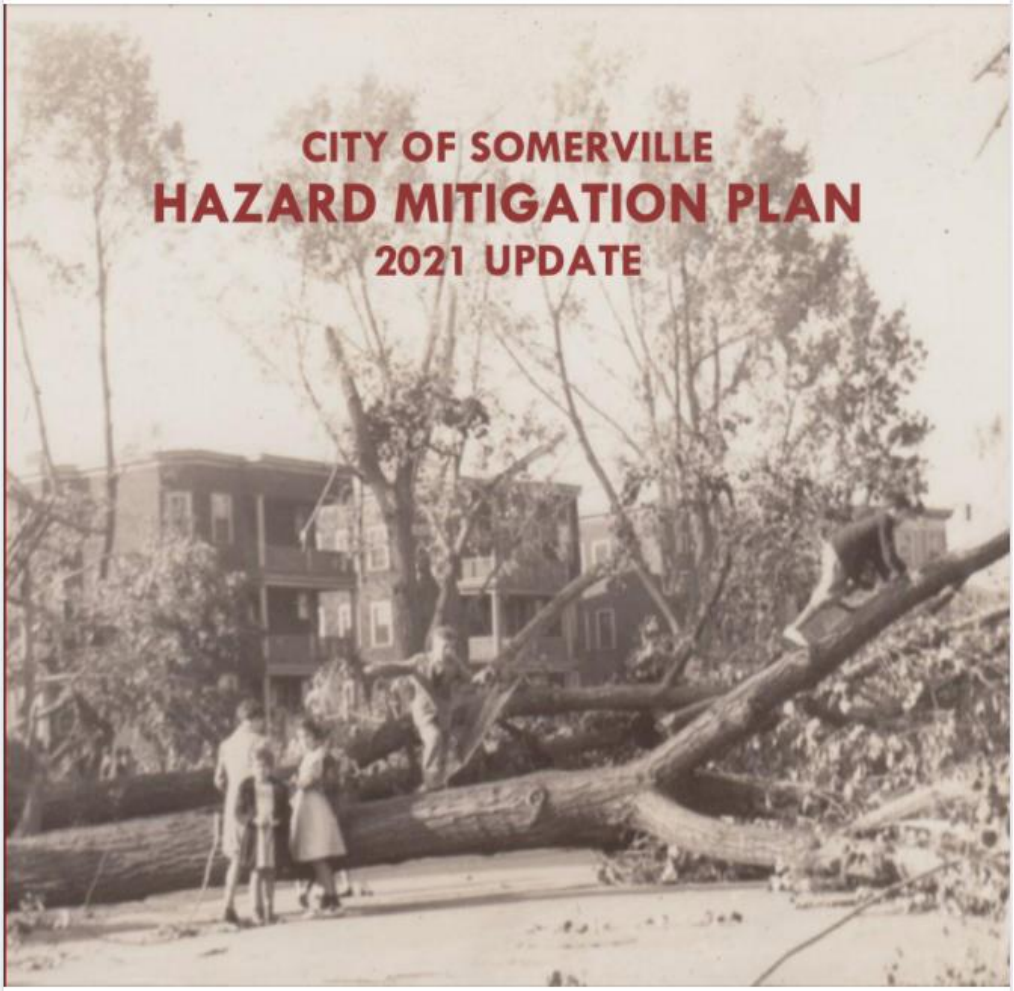
APPENDIX C: PUBLIC MEETINGS

City of Somerville (Official)
December 7 at 6:07 PM ·

The City of Somerville would like to hear your concerns and ideas for mitigating natural hazards in our community! Here's how:

1) Complete the Somerville Hazards Survey at mapc.ma/SomervilleHazardsSurvey. The anonymous survey is available in multiple languages.

2) Check out the newly published draft of the Somerville Hazard Mitigation Plan - 2021 Update at mapc.org/resource-library/somerville-hmp. You can submit comments on the draft somervillehazards@mapc.org.... **See more**



3 2 Comments 3 Shares

Like Comment Share

City of Somerville @SomervilleCity · Dec 7

The City wants to hear from you about natural hazards!
✅Complete the Hazards Survey at mapc.ma/SomervilleHaza...
✅Email somervillehazards@mapc.org with comments on the new draft of the Somerville Hazard Mitigation Plan (at mapc.org/resource-libra...). Survey & comments due 12/10.

3 3

Notice of Public Meeting on Somerville Hazard Mitigation Plan, December 1, 2021, at 7:00 PM

TO: City and Town Clerks in Arlington, Boston, Cambridge, Chelsea, and Everett, MA

PUBLIC MEETING NOTICE
TOWN OF SOMERVILLE
MEETING ON HAZARD MITIGATION PLAN

The City of Somerville has prepared its draft *Hazard Mitigation Plan 2021 Update* to reduce the City's vulnerability to natural hazards such as flooding, hurricanes, and winter storms.

As part of the planning process, all neighboring communities to Somerville are being notified of a public meeting on the draft plan to be hosted by the Somerville Hazard Mitigation Team as follows:

Wednesday, December 1, 2021 at 7:00 PM
Remote meeting via Zoom. To register and receive the Zoom link:
https://tinyurl.com/somerville-meeting
The Zoom meeting link will be sent by email

A flyer announcing the meeting details and registration link is attached. If you have any questions about this, please feel free to contact me.

Best regards,

Martin Pillsbury
Director of Environmental Planning
Metropolitan Area Planning Council
60 Temple Place
Boston, MA 02111
617-939-3896
mpillsbury@mapc.org

APPENDIX D: PLAN ADOPTION

[TO BE COMPLETED AND SIGNED AFTER FEMA ISSUES
A NOTICE THAT THE PLAN IS "APPROVABLE PENDING ADOPTION"]

< PRINT ON CITY LETTERHEAD >

CERTIFICATE OF ADOPTION
CITY OF SOMERVILLE, MASSACHUSETTS

A RESOLUTION ADOPTING THE
CITY OF SOMERVILLE HAZARD MITIGATION PLAN 2022 Update

WHEREAS the City of Somerville established a Committee to prepare the *City of Somerville Hazard Mitigation Plan 2022 Update*; and

WHEREAS the *City of Somerville Hazard Mitigation Plan 2022 Update* contains several potential future projects to mitigate potential impacts from natural hazards in the City of Somerville, and

WHEREAS duly noticed public meetings were held by the Somerville Conservation Commission on October 26, 2021, and the Somerville Hazard Mitigation Team on December 1, 2021, and

WHEREAS the City of Somerville authorizes responsible departments and/or agencies to execute their responsibilities demonstrated in the plan,

NOW, THEREFORE BE IT RESOLVED that the Somerville City Council adopts the *City of Somerville Hazard Mitigation Plan 2022 Update*, in accordance with M.G.L. 40 §4 or the charter and ordinances of the City of Somerville.

ADOPTED AND SIGNED this Date _____

_____
Signature

_____
Name and Title

APPENDIX F: PUBLIC COMMENTS

The City received one public comment from <frannie.bui@gmail.com>, shown below. As a result of this comment, an additional local flooding site at Lake Street was added to the plan.

My comments:

- There is no evidence that the Hazard Mitigation Plan contains information specific to Somerville, including new features related to crowd sourcing locations of flooding. Middlesex County is quite large, covers many communities, and Somerville-specific risks and problems need to be considered.
- Why wasn't the data submitted as part of the 311 system that citizens use to report the actual flood events and actual impacts to citizens? Table 6 is lacking. Why is this not a map showing where these locations are? "Locally Identified" does not seem to be appropriate in this context. See:
- August 10 2008 https://www.youtube.com/watch?v=t8Clcq2AUXM

August 27 2011 https://www.youtube.com/watch?v=VEpVs4ESWk4&app=desktop

July 24 2014 https://www.youtube.com/watch?v=irZ77UQYmJ8&feature=youtu.be

Sept 30 2015 9/30/15 Flood

- I found the lack of commas throughout the entire document and in the tables very difficult to discern.
- There are errors, omissions, and typos throughout the entire document. A technical editor needs to review in great detail and update the text (missing dates, numbers, errant footnotes, "db" in Table 24, Table XX on page 72, Map xx, Error in Bookmark, table of contents, missing table references, measurement units, etc.). This needs to be quality reviewed and vastly improved.
- Figure 12 - what is the purpose of showing Religious Centers in relation to the 100 year coastal storm event? This is confusing and extraneous data.
- Table 22 - does not adequately demonstrate the heavy snow events and its magnitude. See 2011-2012 where it was not just an individual event, but the combination of multiple events in a single season, and the impacts from the snow season on citizens (i.e., nowhere to put snow, flooding related to snow, challenges for citizens to mobilize because of snow)
  - You talk about the impacts from a 2015 event in the discussion, but there is no correlation to what is in the table.
- Table 26 - the impact of Thunderstorms is not necessarily just the wind speed, but the rainfall amount as well -- that discernment is not clear in this table and how it was impacted due to flooding. Magnitude is a misnomer here - either replace it with wind speed, or add the total rainfall amount in inches per hour and total rainfall. How does this relate to recurrence interval for intensity and duration, and what is the stormwater system designed to handle?
- Why is Land Use/Development, etc. in the Risk Assessment Section? Should these sections be split out into Hazards vs. Exposure = Risk?
- Where is a summary of the highest probable hazards that impact the City of Somerville?
- Why should New Development Table include Landslide Risk if in the previous Hazard section this is discussed:

"Somerville is classified as having low susceptibility and a low incidence of landslides (see Map 4, Appendix B). There have been no recorded landslides in Somerville" --- It is written in the Hazards section that flooding is a potential hazard that impacts the majority of the City -- and that flooding has no bounds,

outside of the FEMA flood zones. Should the new development consider the potential of flooding, and not just the FEMA flood zones.

- How was the 10-ft in sea level rise chosen for the New Development section? That seems the most extreme of extreme.
- Critical facilities - all police stations, all urgent care, all transportation facilities, including new transit stations? Commuter-rail tracks flood in Union Square

COMMUTER-RAIL TRACKS FLOOD IN UNION SQUARE

Somerville City Councilor Ben Ewen-Campen captured the scene along the Fitchburg Line tracks, next to the impend...

- It seems strange that the Estimated Damages from Hurricanes are "approximated" as the 100-year and 500-year event, but the Estimated Damages from Flooding are vastly different.
- The building replacement value based on 2014$ is a significant gap in this plan. That was over 7 years ago, and if anyone is paying attention to the housing market and building stock, the impact of a disaster on this City would be vastly different in totals. This needs to be adjusted to accurately reflect CURRENT conditions.
- It still seems unclear of what the actual projects are that the City is planning to fund to mitigate flooding. There are over 19 "high" priority projects -- how are they ranked via cost effectiveness, and how is the City going to budget or submit for funding to push these projects forward?
- Nowhere in the plan is there a discussion with how the "Composite Natural Hazards" are chosen, i.e., the methodology. Are all hazards equally weighted? That seems inappropriate for this context for the City.
- Map 5 is hard to read. If its all the same wind speed, then why not show it as such? The hatching on the storm surge is very hard to discern.
- Map 8 hard to read.
- What are actual mitigation actions that the City is going to take? Can those be outlined in how it ties into any Capital Improvement Plans?

APPENDIX F: NATURAL HAZARD SURVEY

Somerville Natural Hazards Survey – Results as of 12/16/21

The City of Somerville distributed an online public survey seeking input from residents and businesses on their concerns about natural hazards. The survey is hosted on MAPC's Qualtrics platform. The city posted the survey on its website and social media channels, and the Somerville Office of Immigrant Affairs had the survey translated into four languages: Spanish, Portuguese, Haitian Creole, and Nepali.

As of December 16, 2021, the survey received 162 responses. The City will continue to distribute the survey in order to encourage more participation and gather more input.

The responses to the survey's questions are summarized below.

Many natural hazards may affect Somerville, as listed below. Please select the top three hazards you are concerned with by entering 1, 2, and 3 (where 1 is your greatest concern) in the boxes by each one below.

Ranking chosen	1st	2nd	3rd
Sea level rise (increasing ocean levels due to global warming)	27%	32%	41%
Intense winter storms (blizzards/ice storms)	25%	36%	39%
Intense winds (tree damage/power outages)	16%	39%	45%
Flooding and intense rainstorms	61%	22%	17%
Extreme heat / Heat waves	24%	41%	35%
Drought/Brushfires	20%	40%	40%

Natural hazards may have impacts on the city's infrastructure, its people, and its natural resources. Please indicate your first, second and third priorities for these impacts by entering 1, 2, and 3 (where 1 is your highest priority) next to the items below.

Priority Chosen	1st	2nd	3rd
3 Societal impacts (public health, vulnerable populations, social resilience)	43%	39%	18%
2 Natural resources impacts (wetlands, rivers, streams, urban trees, wildlife)	8%	26%	64%
1 Infrastructure impacts (transportation, energy, communications, water)	51%	33%	16%

For impacts on infrastructure, please indicate your greatest concern (please check one):

1	Impacts on Transportation: roads, transit system, sidewalks, pedestrian, bicycle facilities	24%
2	Impacts on Energy: Electric power outages, delivery of heating oil, natural gas distribution	33%
3	Impacts on Water supply and wastewater services: shortages, pollution, sewer overflows	33%
4	Impacts on Communications: cell phone service, internet connection, cable, telephone	10%

For impacts on people, please indicate your greatest concern (please check one):

1	Senior citizens	25%
2	People who live alone	8%
3	Low-income residents / public housing residents	37%
4	People with health problems (asthma, reliance on medical devices)	26%
5	People who speak limited English	4%

For natural resources impacts, please indicate your greatest concern (please check one):

1	Impacts on wetlands, rivers and streams (floods, droughts, pollution, recreation areas)	26%
2	Impacts on urban trees, parks and open space (tree diseases, pests, invasive species)	17%
3	Impacts on air quality (pollution, unhealthy air quality, asthma)	52%
4	Impacts on wildlife (loss of wildlife habitat, reduced wildlife diversity and populations)	4%

For impacts on businesses and municipal operations, please indicate your greatest concern (please check one):

1	Impacts on emergency services	39%
2	School and daycare closures	12%
3	Closure of local businesses	7%
4	Disruption of municipal and social services	30%
5	Access to medical services	12%

Are there any specific locations, facilities, or resources in Somerville that you are most concerned about being impacted by natural hazards? Please list these in the text box below (you may enter more than one item):

1. Flooding at the corner of Ivaloo St and Harrison St. It happens nearly every rainstorm.
2. Dangerous intersections becoming even riskier for pedestrians and bikes during storms
3. No street lights at McGrath highway to Target area, most of the poll light are out of order,
4. Duck Village
5. Sub sandwich shops, food stores, gas stations, police and fire response, trash pick up, plowing snow
6. flooding/drainage
7. Sewer system overflow
8. Mystic Ave (including the street, housing, and businesses)--flooding during intense storms.
9. Access to stores for food, access to get medical help and getting responders to people
10. Flooding in Gilman square, tree limbs coming down onto wires
11. Union Sq/ flooding
12. Road flooding on Somerville Ave
13. Areas that are projected to flood more w/sea level rise-near Alewife Brook & the Mystic, Ward 2
14. MassDOT fucking over East Somerville (I93 & Mystic Ave)
15. Newly built up areas - we've just put in significant investments, hope they survive.
16. for all previous questions, I needed an "all of the above" response.
17. Aging sewer, water, and gas pipes; low areas which experience flooding already; near highways
18. Energy grid, sewage, water, emergency response and schools
19. Electricity, basic tree trimming
20. When rising seas flood and destroy downtown Boston, can Somerville still exist?
21. Quando chove ruas ficam inundadas (When it rains, roads are flooded)
22. Bus stops (flooding and extreme heat)
23. Interruption for water and food supply, and utility
24. lack of access to basic resources (such as food) that families may rely on daily
25. Inundacoes nas ruas quando chove (Flooding of roads when It rains)
26. Basement Flooding/Poor Drainage
27. Flooding is already happening and a major concern. Summer\Vinal area is being destroyed.
28. Schools (as the recent unavailability of heat showed), outdated Brown & Winter Hill buildings
29. Union Square
30. Old power posts that are already at an angle falling
31. Las escuelas, los hospitals (the schools, the hospitals)
32. Rising water table/storm water runoff (our basement has been flooding more frequently than ever
33. senior living facilities if power is lost and A/C and elevators are not available during heatwave
34. sewage flooding into the streets and basements in Ward 2
35. Flooded cellars .Trees that need to be cut down.
36. god forbid the bike lanes get knocked out of place....
37. Trees in Ellsworth Street. One is damaged and another is due to be cut down where hawks like to hang
38. The area around Foss Park floods repeatedly ever summer, inundating streets and basements.
39. Access to medical care, especially emergency medical care
40. Alewife Brook, Mystic River watershed
41. Roadways
42. Low lying areas that are prone to flooding, areas with a high water table that affects basements

43. Known flood zones like the Washington St underpass, overhead electrical lines in many places.
44. West Somerville near Route 16 floods
45. College Ave and Francesca….middle of the street is a natural hazard
46. Mystic River area flooding
47. Emergency services (fire/ambulance during snow & flooding)

Please indicate if you are responding as a Somerville resident, business, organization, or other:

1	Somerville resident	98%
2	Somerville business	1%
3	Somerville organization (school, church, non-profit group, etc.)	2%

Which of the following preparedness measures have you taken for your home or business?

1	Gathered emergency supplies	62%
2	Sought preparedness information	46%
3	Created emergency plans	25%
4	Set aside some money for emergencies	78%
5	Purchased flood insurance	6%

What do you think is the most important thing the City should do to help residents and businesses prepare for natural hazards?

1. Emergency shelters , space for dogs and cats in shelters etc
2. make list of recommended emergency supplies; provide boxes of these to the poor
3. Improve storm water sewers to mitigate flooding.
4. Street flooding, power outages
5. Set up alternative networks for communicating with vulnerable populations in case of comms outage
6. Support programs and information
7. Pest control, resolving the stormwater issues, low income housing readiness (e.g., for extreme heat)
8. Provide minimum ER groceries fund or delivered during emergency for people with children and senior
9. Fix the sewer system
10. Rat extermination now, expunge useless jobs, have emergency high profile vehicles.
11. Keep informed, provide insight into potential ramifications
12. Overflow storage tanks
13. Mitigating and fighting climate change. Otherwise, have established facilities to help people.
14. Provide paper area maps and other emergency resources to residents
15. Everything they possibly can or you can be sure you have lost your fellow constituents
16. Help people get their homes properly insulated (even renters) in case of winter power and gas outage

17. Raise awareness, be a backup place if our home fails
18. drainage pump improvements on mystic
19. De-incentivize car ownership
20. Prioritize residents over cars and businesses
21. Decrease the cost of housing, so homeless get homes and everyone can prepare better
22. Upgrade water management infrastructure and system
23. Provide emergency supplies to all residents, particularly those in public housing or with low income
24. Implement a land value tax and use some of those funds to rapidly replace our sewer system
25. All senior citizens (over 70) should be given an emergency kit from the city.
26. Infrastructure upgrades - sewer system, build more housing on higher ground
27. Make Somerville inhospitable to cars in favor of walking, biking, and mass transit
28. Build permanent capacity within the city government to address the impacts of climate change.
29. Heat pumps. The less reliant Somerville is on large grids that can fail, the more robust we'll be.
30. not enough room to answer here - but require all new building to be 100% LEED certified for one.
31. Improve infrastructure, improve communications during outages and emergencies, fix areas of concern
32. Rebuild the grid, incentives for electric vehicles and solar panels, update sewage
33. Fund fire, police, and Dpw departments
34. garantir alimento em caso de emrgencia (guarantee food at home in case of emergency)
35. warn, set up emergency shelters
36. Set up neighborhood based check ins for vulnerable residents during extreme heat, drainage upgrades
37. Advance notice, Ready for Emergency Rescue, Additional communicational arrangements
38. Communication in multiple languages and ways on where to access resources in case of natural hazard.
39. City already provides great and timely information, maybe more boots on the ground also?
40. identify at-risk residents and ensure they are safe
41. Education on preparedness, sample plans. Financial supports where needed to carry out plans
42. informar como agir (information on how to respond)
43. Comunicacao em nosso idioma (communication in our language)
44. Planning/Supplies
45. Fix flooding issues now so that severe events ave less impact
46. Sewer replacement and separation projects
47. PSAs about what we should have ready in our house
48. provide checklist flyers or website materials regarding supplies, preparedness, and plans (in Sept)
49. Water not get polluted with extreme rain
50. Repair streets, have better snow removal plan,
51. Reuniones de información en casos de desastres naturales (information in cases of natural disasters)
52. Encourage/incentivize asphalt/concrete removal
53. Lists of emergency supplies and getting supplies to vulnerable residents like the elderly .
54. make sure emergency instructions are transmitted quickly and in multiple languages
55. separate sewage and rain drainage
56. education on what to do in such a situation, including seeking city assistance
57. Update infrastructure
58. Have a person not a robot answer the phones. Pay to have cellars cleaned after flooding.
59. fix the roads, open the bridges, enforce traffic/parking regs...maybe act like a real city
60. Plow the streets properly especially around the schools, make people accountable, they don’t shovel
61. Incentivize the removal of paving from yards, swales for control of run off, plant more street trees
62. Strengthen physical infrastructure and plan for increasingly severe storms

63. Identify current structural weaknesses likely to be impacted by increasingly severe weather
64. Have contingency plans in place, have money set aside to help, build robust green infrastructure
65. Tell them what, specifically, they should be doing + are at risk for by address.
66. Preach self reliance
67. Emergency preparedness checklist or starter kit
68. Each season post info on social media, take care of city trees, create an assistance fund
69. Educate elders and low-income citizens about hazards and subsidize adaptation.
70. Remove bike and bus lanes so residents can evacuate in an emergency
71. Help creating emergency plans
72. EMERGENCY PLANNING AND SUPPLIES
73. Do things to mitigate climate change--plant trees, green space; support green energy